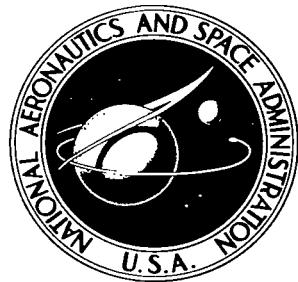


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# AZIMUTHAL MAGNETIC FIELD OF A THICK, FINITE-LENGTH, HELICAL SOLENOID

*by Edmund E. Callaghan and James C. Stoll  
Lewis Research Center  
Cleveland, Ohio*

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SUMMARY

The expression for the azimuthal component of the magnetic-field intensity of a thick, finite-length, helical solenoid is derived. An analytic solution is obtained in terms of complete elliptic integrals. Numerical results electronically computed for several combinations of coil thickness and length for a constant current density are presented in dimensionless form in a table and in sample graphs.

INTRODUCTION

The variation of axial and radial components of the magnetic-field intensity off the axis of an infinitely thin, but finite-length, solenoid (cylindrical current sheet) is reported in reference 1. Similar calculations for a thick, finite-length solenoid are reported in reference 2. The three components (axial, radial, and azimuthal) of the magnetic-field intensity of an infinitely thin, but finite-length, helical solenoid (helical current sheet) are presented in reference 3, wherein the helical current density is treated as the vector sum of an azimuthal and a longitudinal current density. The resulting axial and radial field relations are the same as those derived in reference 1.

In the work reported herein, the helical current-density vector is treated, as in reference 3, as the sum of an azimuthal and a longitudinal current density. Since the radial and axial fields (due to the azimuthal current density) are reported in reference 2, only the azimuthal magnetic field that results from the longitudinal current density is reported herein.

SYMBOLS

The rationalized meter-kilogram-second system of units is used herein.

$a, \theta, l$  cylindrical coordinates of source point

$a_l$  inside radius of coil

$a_2$	outside radius of coil
$E(k)$	elliptic integral of second kind
$H_\theta$	azimuthal component of magnetic-field intensity
$J$	constant current density
$K(k)$	elliptic integral of first kind
$k^2$	$\frac{4ar}{\xi^2 + (a + r)^2}$
$L$	half-length of coil
$Q$	$\sqrt{\xi^2 + a^2 + r^2 - 2ar \cos \theta}$
$r, 0^\circ, z$	cylindrical coordinates of field point
$\operatorname{sn} u$	Jacobian elliptic function
$\lambda_o(\phi, k)$	Heuman lambda function
$\xi$	$z - l$
$\xi_1$	$z - L$
$\xi_2$	$z + L$
$\phi$	$\tan^{-1} \left  \frac{\xi}{a - r} \right $
$\psi$	helical angle

#### EQUATION FOR AZIMUTHAL FIELD

The expression for the azimuthal component of the magnetic field of an infinitely thin, finite-length, helical solenoid is given by reference 3 as

$$\frac{2\pi H_\theta}{J \sin \psi} = a \int_0^\pi \frac{\xi(r - a \cos \theta) d\theta}{(a^2 + r^2 - 2ar \cos \theta) \sqrt{\xi^2 + a^2 + r^2 - 2ar \cos \theta}} \Bigg|_{\xi_1}^{\xi_2} \quad (1)$$

The expression for the azimuthal component of the magnetic field for a thick, finite-length, helical solenoid (illustrated in fig. 1) is obtained by integrating equation (1) with respect to the coil radius  $a$ :

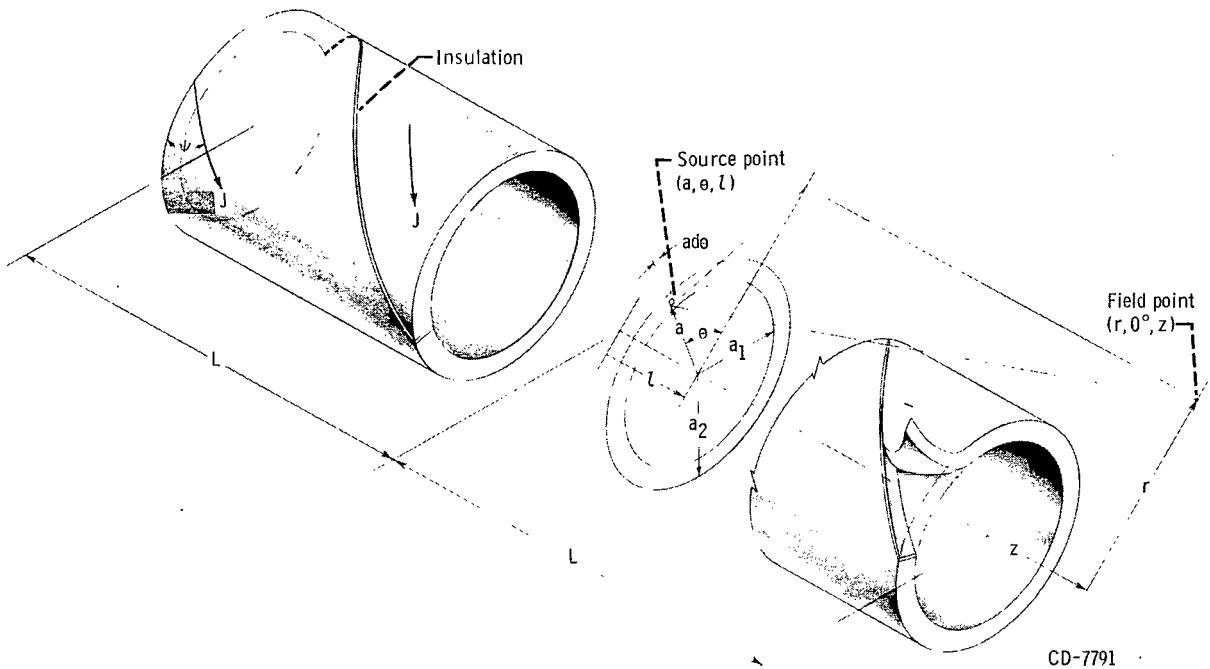


Figure 1. - Coil geometry.

$$\frac{2\pi H_\theta}{J \sin \psi} = \int_{a_1}^{a_2} \int_0^\pi \frac{a \xi (r - a \cos \theta) d\theta da}{(a^2 + r^2 - 2ar \cos \theta) \sqrt{\xi^2 + a^2 + r^2 - 2ar \cos \theta}} \Big|_{\xi_1}^{\xi_2} \quad (2)$$

The integration of equation (2) with respect to  $a$  yields:

$$\frac{2\pi H_\theta}{J \sin \psi} = \int_0^\pi \frac{\xi a^2 r \sin^2 \theta d\theta}{(a^2 + r^2 - 2ar \cos \theta) \sqrt{\xi^2 + a^2 + r^2 - 2ar \cos \theta}} \Big|_{\xi_1}^{\xi_2} \quad (3)$$

The details of this integration are given in the appendix.

The integration of equation (3) with respect to  $\theta$  yields:

$$\frac{2\pi H_\theta}{J \sin \psi} = \frac{\xi}{2} \sqrt{\frac{a}{r}} \left\{ \frac{(r - a)^2}{2ar} kK(k) + \frac{2}{k} [K(k) - E(k)] - \frac{\pi |r^2 - a^2|}{\sqrt{4ar} |\xi|} \lambda_0(\phi, k) \right\} \quad (4)$$

$\xi_2 | a_2$   
 $\xi_1 | a_1$

The details of this integration are given in the appendix.

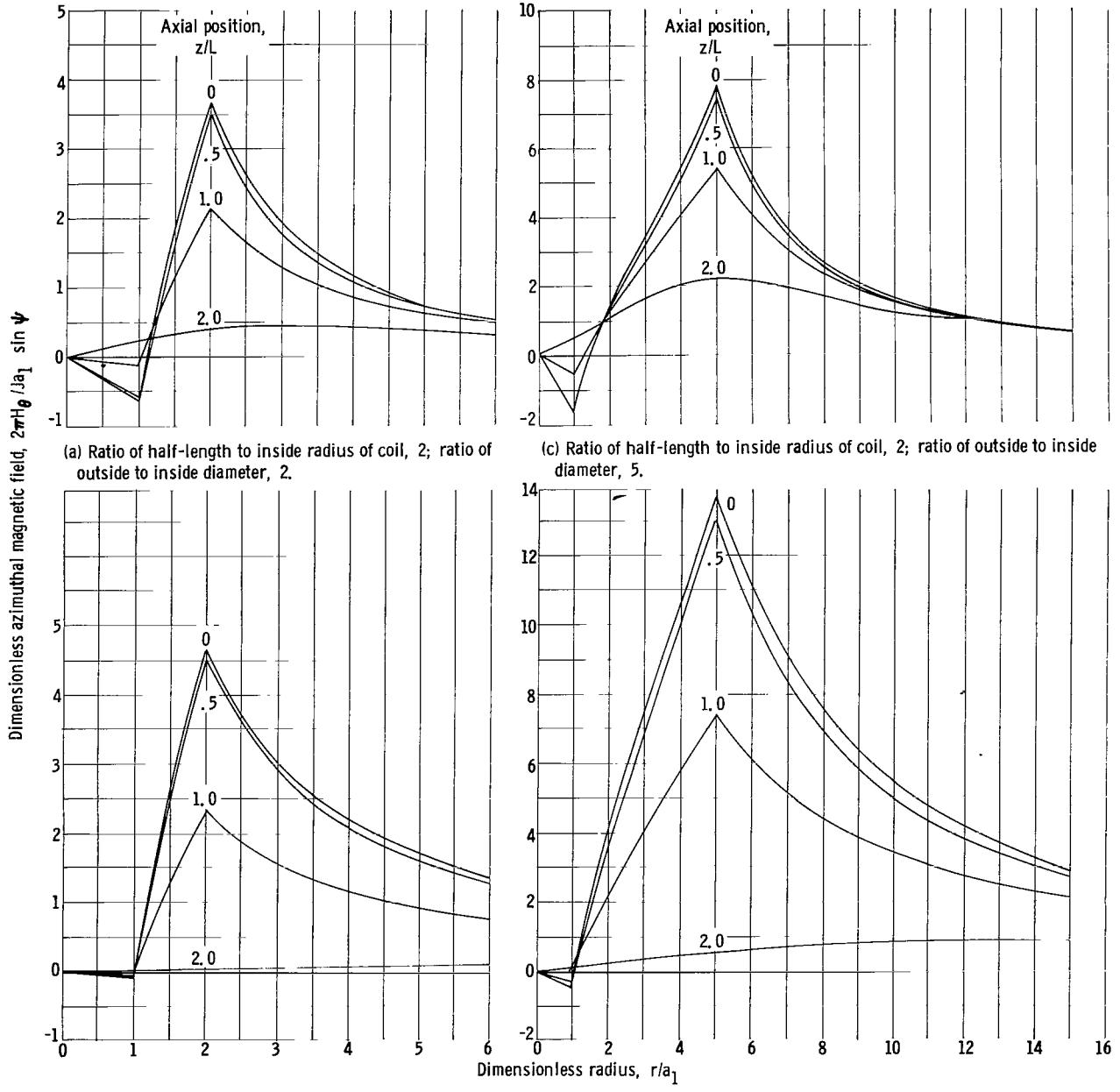


Figure 2. - Azimuthal magnetic field of thick helical solenoid at constant current density.

A difficulty might be anticipated in the evaluation of equation (4) when  $\xi_1 = 0$  and  $r = a_1$  or  $a_2$  (field point at the end of the inner or the outer surface of the coil). For these values the modulus of the elliptic functions  $k$  becomes unity and  $K(1) = \infty$ . Evaluation of the terms in equation (4) as these values are approached, however, indicates that they become zero. Thus, when  $r = a = a_1$ , the definitions of  $k$  and  $\xi$  yield

$$\xi = \frac{2a_1 k'}{k}$$

where  $k'$  is the complementary modulus  $\sqrt{1 - k^2}$ . For the specific case  $\xi_1 = 0$  ( $k = 1$ ,  $k' = 0$ ) it can easily be shown that  $k'K(k) = 0$  when  $k = 1$ . Since  $K(k)$  is multiplied by  $\xi$  (and therefore  $k'$ ) in equation (4) and the other terms are clearly zero, the anticipated difficulty does not arise.

#### DISCUSSION

In table I the dimensionless azimuthal field  $2\pi H_\theta / Ja_1 \sin \psi$  is given as a function of the radius or distance from the axis of symmetry for nine axial positions, namely,  $z/L = 0, 0.25, 0.50, 0.75, 1.00, 1.25, 1.50, 1.75$ , and  $2.00$  and all possible combinations of  $a_2/a_1 = 1.5, 2, 3, 4$ , and  $5$  with  $L/a_1 = 1, 2, 3, 5$ , and  $10$ . The values are tabulated for distances  $r/a_1$  from the axis out to three times the value of  $a_2/a_1$ .

The curves shown in figure 2 are examples of plots obtained from table I. In figure 2(a) the azimuthal field is given as a function of the dimensionless radius  $r/a_1$  for four  $z/L$  values for the case  $a_2/a_1 = 2$  and  $L/a_1 = 2$ . In figures 2(b), (c), and (d) the same results are given for  $a_2/a_1 = 2$  and  $L/a_1 = 10$ ,  $a_2/a_1 = 5$  and  $L/a_1 = 2$ , and  $a_2/a_1 = 5$  and  $L/a_1 = 10$ , respectively.

Some of the properties exhibited by figure 2 and table I are as follows:

- (1) The maximum value of the azimuthal field inside the coil occurs at the inner wall of the coil, that is, at  $r = a_1$ .
- (2) The maximum value of the azimuthal field outside the coil occurs at the outer wall of the coil, at  $r = a_2$ , and is much greater than that inside the coil.
- (3) As the thickness increases, the field increases both inside and outside for a given coil length.
- (4) As the length increases, the field inside decreases and the field outside increases for a given coil thickness.

Since the magnetic fields of the lead-in wires depend on the geometry of the leads, the magnetic fields due to leads are neglected in this analysis.

In an actual situation with a specified lead-in wire geometry, however, the fields of the leads must be included because they are of the same order of magnitude as the azimuthal field produced by the coil itself.

Lewis Research Center  
National Aeronautics and Space Administration  
Cleveland, Ohio, April 14, 1964

## APPENDIX - INTEGRATION OF EQUATIONS (2) AND (3)

The expression for the azimuthal component of the magnetic field for a thick, finite-length, helical solenoid is

$$\frac{2\pi H_\theta}{J \sin \psi} = \int_{a_1}^{a_2} \int_0^\pi \frac{a\xi(r - a \cos \theta) d\theta da}{(a^2 + r^2 - 2ar \cos \theta) \sqrt{\xi^2 + a^2 + r^2 - 2ar \cos \theta}} \Bigg|_{\xi_1}^{\xi_2} \quad (2)$$

Note that

$$\begin{aligned} \frac{-\xi}{(a^2 + r^2 - 2ar \cos \theta)Q} &= \frac{-\xi + Q - Q}{(Q + \xi)(Q - \xi)Q} \\ &= \frac{1}{(Q + \xi)Q} - \frac{1}{a^2 + r^2 - 2ar \cos \theta} \end{aligned}$$

Then

$$\frac{2\pi H_\theta}{J \sin \psi} = \int_{a_1}^{a_2} \int_0^\pi -a(r - a \cos \theta) \left[ \frac{1}{(Q + \xi)Q} - \frac{1}{a^2 + r^2 - 2ar \cos \theta} \right] d\theta da \Bigg|_{\xi_1}^{\xi_2}$$

When the limits on  $\xi$  are applied, the second term within the braces vanishes since it is independent of  $\xi$ , and

$$\frac{2\pi H_\theta}{J \sin \psi} = \int_{a_1}^{a_2} \int_0^\pi \frac{-a(r - a \cos \theta) d\theta da}{(Q + \xi)Q} \Bigg|_{\xi_1}^{\xi_2}$$

If  $r - a \cos \theta$  is written as  $r \sin^2 \theta - \cos \theta(a - r \cos \theta)$ ,

$$\begin{aligned} \frac{2\pi H_\theta}{J \sin \psi} &= \int_{a_1}^{a_2} \int_0^\pi \frac{-ar \sin^2 \theta d\theta da}{(Q + \xi)Q} \Bigg|_{\xi_1}^{\xi_2} + \int_{a_1}^{a_2} \int_0^\pi \frac{a \cos \theta(a - r \cos \theta) d\theta da}{(Q + \xi)Q} \Bigg|_{\xi_1}^{\xi_2} \end{aligned} \quad (A1)$$

Integrating the first integral of equation (Al) by parts on  $\theta$  with

$$du = \frac{-ar \sin \theta d\theta}{(Q + \xi)Q}$$

$$v = \sin \theta$$

yields

$$-\int_{a_1}^{a_2} \sin \theta \ln(\xi + Q) da \Big|_{\xi_1}^{\xi_2} + \int_0^\pi \int_{a_1}^{a_2} \cos \theta \ln(\xi + Q) da d\theta \Big|_{\xi_1}^{\xi_2}$$

of which the first term vanishes when the limits on  $\theta$  are applied. Integrating the second integral of equation (Al) by parts on  $a$  with

$$du = \frac{(a - r \cos \theta) da}{(\xi + Q)Q}$$

$$v = a \cos \theta$$

yields

$$\int_0^\pi a \cos \theta \ln(\xi + Q) d\theta \Big|_{\xi_1}^{\xi_2} - \int_0^\pi \int_{a_1}^{a_2} \cos \theta \ln(\xi + Q) da d\theta \Big|_{\xi_1}^{\xi_2}$$

Hence

$$\frac{2\pi H_\theta}{J \sin \psi} = \int_0^\pi a \cos \theta \ln(\xi + Q) d\theta \Big|_{\xi_1}^{\xi_2} \quad (A2)$$

Integrating equation (A2) by parts on  $\theta$  with

$$du = a \cos \theta d\theta$$

$$v = \ln(\xi + Q)$$

yields

$$\frac{2\pi H_\theta}{J \sin \psi} = a \sin \theta \ln(\xi + Q) \begin{vmatrix} \xi_2 & a_2 \\ \xi_1 & a_1 \end{vmatrix} \int_0^\pi \frac{a^2 r \sin^2 \theta d\theta}{(\xi + Q)Q} \begin{vmatrix} \xi_2 & a_2 \\ \xi_1 & a_1 \end{vmatrix}$$

of which the first term vanishes when the limits of  $\theta$  are applied. Multiplying the second term by  $(Q - \xi)/(Q - \xi)$  and applying the limits on  $\xi$  give

$$\frac{2\pi H_\theta}{J \sin \psi} = \int_0^\pi \frac{\xi a^2 r \sin^2 \theta d\theta}{(a^2 + r^2 - 2ar \cos \theta) \sqrt{\xi^2 + a^2 + r^2 - 2ar \cos \theta}} \begin{vmatrix} \xi_2 & a_2 \\ \xi_1 & a_1 \end{vmatrix} \quad (3)$$

Introducing a change of variable  $t = \cos \theta$  gives

$$\frac{2\pi H_\theta}{J \sin \psi} = - \int_{-1}^1 \frac{\xi a^2 r (1 - t^2) dt}{\sqrt{1 - t^2} (a^2 + r^2 - 2art) \sqrt{\xi^2 + a^2 + r^2 - 2art}} \begin{vmatrix} \xi_2 & a_2 \\ \xi_1 & a_1 \end{vmatrix}$$

$$= \frac{\xi a^2 r}{(2ar)^{3/2}} \int_{-1}^1 \frac{(1 - t^2) dt}{\left( \frac{a^2 + r^2}{2ar} - t \right) \sqrt{\left( \frac{\xi^2 + a^2 + r^2}{2ar} - t \right) (1 - t^2)}} \begin{vmatrix} \xi_2 & a_2 \\ \xi_1 & a_1 \end{vmatrix} \quad (A3)$$

Let  $p = (a^2 + r^2)/2ar$ ,  $q = (\xi^2 + a^2 + r^2)/2ar$ , and substitute  $1 - t^2 = 1 - pt + (p - t)t$  in the numerator and denominator. Equation (A3) can then be written as:

$$\frac{2\pi H_\theta}{J \sin \psi} = \frac{\xi a^2 r}{(2ar)^{3/2}} \left\{ \int_{-1}^1 \frac{t dt}{\sqrt{(q - t)(t + 1)(1 - t)}} + p \int_{-1}^1 \frac{\left( \frac{1}{p} - t \right) dt}{(p - t) \sqrt{(q - t)(t + 1)(1 - t)}} \right\} \begin{vmatrix} \xi_2 & a_2 \\ \xi_1 & a_1 \end{vmatrix}$$

The first integral within the braces can be evaluated by using formulas 233.17 and 331.01 of reference 4; the second integral can be evaluated by using formulas 233.19 and 413.06 of reference 4. The resulting equations are

$$\frac{2\pi H_\theta}{J \sin \psi} = \frac{\xi a^2 r}{(2ar)^{3/2}} \left\{ \begin{array}{l} \int_0^{K(k)} (1 - 2 \operatorname{sn}^2 u) du \\ + \sqrt{2k} \int_0^{K(k)} \frac{1 - \frac{2(a^2 + r^2)}{(a + r)^2} \operatorname{sn}^2 u}{1 - \frac{4ar}{(a + r)^2} \operatorname{sn}^2 u} du \end{array} \right\} \begin{vmatrix} \xi_2 & a_2 \\ \xi_1 & a_1 \end{vmatrix}$$

$$\frac{2\pi H_\theta}{J \sin \psi} = \frac{\xi}{2} \sqrt{\frac{a}{r}} \left\{ \frac{(r - a)^2}{2ar} k K(k) + \frac{2}{k} [K(k) - E(k)] - \frac{\pi |r^2 - a^2|}{\sqrt{4ar} |\xi|} \lambda_o(\phi, k) \right\} \begin{vmatrix} \xi_2 & a_2 \\ \xi_1 & a_1 \end{vmatrix}$$
(A4)

#### REFERENCES

1. Callaghan, Edmund E., and Maslen, Stephen H.: The Magnetic Field of a Finite Solenoid. NASA TN D-465, 1960.
2. Brown, Gerald V., Flax, Lawrence, Itean, Eugene C., and Laurence, James C.: Axial and Radial Magnetic Fields of Thick, Finite-Length Solenoids. NASA TR R-170, 1963.
3. Sass, A. R., and Stoll, James C.: Magnetic Field of a Finite Helical Solenoid. NASA TN D-1993, 1963.
4. Byrd, Paul F., and Friedman, Morris D.: Handbook of Elliptic Integrals for Engineers and Physicists. Springer-Verlag (Berlin), 1954.

TABLE I. - DIMENSIONLESS AZIMUTHAL MAGNETIC FIELD AT CONSTANT CURRENT DENSITY AS  
FUNCTION OF RADIUS AND AXIAL POSITION

Radius, $r/a_1$	Dimensionless azimuthal field $2\pi H_\theta/Ja_1 \sin \psi$ at axial position $z/L$ of -								
	0	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Ratio of half-length to inside radius of coil, $L/a_1$ , 1; ratio of outside to inside radius, $a_2/a_1$ , 1.5									
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	- .12076	- .11651	- .10212	- .07480	- .03699	.00007	.02526	.03685	.03913
.50	- .24741	- .24038	- .21457	- .15901	- .07338	.01060	.06148	.08062	.08156
.75	- .38306	- .37711	- .35039	- .27260	- .10849	.05291	.12276	.13725	.12919
1.00	- .52440	- .52564	- .52115	- .47110	- .14151	.18419	.22256	.20779	.18068
1.25	.75452	.74180	.70264	.63401	.53530	.43157	.34760	.28198	.23020
1.50	1.84757	1.82592	1.75263	1.58927	1.11115	.62717	.44568	.34040	.26949
1.75	1.39777	1.37432	1.29762	1.14673	.90222	.65138	.48097	.36969	.29279
2.00	1.07755	1.05759	.99576	.88891	.74459	.59396	.46768	.37171	.29989
2.25	.84824	.83318	.78822	.71546	.62256	.52372	.43278	.35630	.29454
2.50	.68178	.67097	.63926	.58928	.52637	.45811	.39188	.33240	.28140
2.75	.55860	.55093	.52857	.49359	.44949	.40073	.35168	.30558	.26420
3.00	.46553	.46004	.44408	.41908	.38733	.35161	.31469	.27880	.24543
3.25	.39374	.38976	.37817	.35994	.33657	.30986	.28165	.25350	.22658
3.50	.33731	.33438	.32581	.31225	.29471	.27440	.25255	.23028	.20849
3.75	.29220	.29000	.28354	.27328	.25989	.24420	.22706	.20929	.19157
4.00	.25559	.25391	.24896	.24107	.23069	.21839	.20480	.19049	.17600
4.25	.22547	.22416	.22032	.21415	.20599	.19624	.18534	.17372	.16180
4.50	.20040	.19937	.19634	.19146	.18496	.17713	.16830	.15880	.14892
Ratio of half-length to inside radius of coil, $L/a_1$ , 1; ratio of outside to inside radius, $a_2/a_1$ , 2									
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	- .20604	- .19835	- .17384	- .13066	- .07348	- .01694	.02470	.04802	.05731
.50	- .42316	- .40915	- .36250	- .27350	- .14644	- .02091	.06413	.10660	.12073
.75	- .65972	- .64338	- .58450	- .45237	- .21816	.01318	.13743	.18594	.19500
1.00	- .91717	- .90578	- .85948	- .73018	- .28757	.15036	.26617	.29224	.28141
1.25	.22830	.22680	.22966	.26194	.35361	.43847	.45049	.42044	.37547
1.50	1.17489	1.15669	1.10213	1.01250	.89542	.76939	.65265	.55191	.46700
1.75	2.03822	2.00560	1.90065	1.70022	1.38430	1.05768	.82447	.66233	.54352
2.00	2.88369	2.84406	2.71494	2.45434	1.84390	1.22170	.92485	.73199	.59512
2.25	2.26005	2.22228	2.10257	1.88129	1.54558	1.19779	.93939	.75462	.61829
2.50	1.79889	1.76812	1.67442	1.51691	1.30835	1.08813	.89493	.73930	.61640
2.75	1.45726	1.43423	1.36596	1.25657	1.11737	.96743	.82538	.70113	.59658
3.00	1.2C133	1.18466	1.13587	1.05910	.96214	.85565	.75005	.65244	.56605
3.25	1.0C640	.99439	.95939	.90451	.83492	.75709	.67741	.60082	.53031
3.50	.85519	.84645	.82100	.78100	.72986	.67172	.61072	.55033	.49299
3.75	.73577	.72932	.71050	.68079	.64244	.59818	.55088	.50292	.45624
4.00	.63990	.63506	.62090	.59842	.56916	.53497	.49779	.45940	.42127
4.25	.56178	.55809	.54725	.52996	.50728	.48048	.45094	.41996	.38866
4.50	.49728	.49442	.48600	.47250	.45466	.43338	.40966	.38445	.35861
4.75	.44340	.44115	.43451	.42382	.40961	.39252	.37328	.35260	.33115
5.00	.39791	.39612	.39081	.38224	.37079	.35692	.34117	.32408	.30617
5.25	.35915	.35770	.35342	.34647	.33713	.32577	.31276	.29853	.28349
5.50	.32585	.32467	.32116	.31547	.30779	.29839	.28756	.27564	.26293
5.75	.29702	.29604	.29315	.28844	.28206	.27422	.26515	.25508	.24429
6.00	.27188	.27107	.26866	.26473	.25939	.25281	.24514	.23660	.22737

Ratio of half-length to inside radius of coil,  $L/a_1$ , 1; ratio of outside to inside radius,  $a_2/a_1$ , 3

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	-.3C971	-.29884	-.26513	-.20787	-.13346	-.05862	.00043	.03881	.06008
.50	-.63538	-.61472	-.54884	-.43034	-.26720	-.10353	.01744	.09059	.12871
.75	-.99072	-.96368	-.87383	-.69390	-.40120	-.10851	.07254	.16836	.21336
1.00	-1.38341	-1.35655	-1.26493	-1.06481	-.53497	-.00646	.19086	.28208	.31851
1.25	-.39708	-.37763	-.31228	-.17913	.03949	.25467	.37850	.43205	.44358
1.50	.35838	.36615	.39230	.44236	.51235	.57613	.60825	.60714	.58274
1.75	.99197	.98714	.97397	.95507	.93071	.89698	.85028	.79209	.72720
2.00	1.56887	1.55161	1.50108	1.42133	1.31950	1.20507	1.08742	.97359	.86762
2.25	2.13364	2.10402	2.01607	1.87465	1.69366	1.49710	1.30844	1.14021	.99497
2.50	2.72016	2.67861	2.55255	2.34166	2.06287	1.76609	1.50040	1.28015	1.10042
2.75	3.35529	3.30440	3.14534	2.85852	2.43353	1.98897	1.64242	1.38002	1.17579
3.00	4.005719	4.00324	3.83200	3.50480	2.80970	2.09449	1.70575	1.42794	1.21545
3.25	3.32060	3.27140	3.11811	2.84334	2.43848	2.01388	1.67889	1.42173	1.21913
3.50	2.75086	2.71100	2.59062	2.39073	2.12764	1.84600	1.58975	1.37290	1.19256
3.75	2.31077	2.28060	2.19133	2.04868	1.86661	1.66772	1.47417	1.29864	1.14481
4.00	1.96797	1.94567	1.88041	1.77751	1.64670	1.50106	1.35346	1.21310	1.08472
4.25	1.69720	1.68077	1.63280	1.55729	1.46078	1.35144	1.23740	1.12519	1.01905
4.50	1.48002	1.46779	1.43205	1.37562	1.30289	1.21920	1.12997	1.03986	.95231
4.75	1.30318	1.29394	1.26689	1.22397	1.16815	1.10305	1.03239	.95955	.88725
5.00	1.15720	1.15010	1.12929	1.09609	1.05256	1.00119	.94462	.88532	.82540
5.25	1.03516	1.02963	1.01336	.98730	.95286	.91181	.86605	.81740	.76752
5.50	.93202	.92764	.91475	.89399	.86636	.83321	.79584	.75564	.71390
5.75	.84394	.84044	.83011	.81337	.79100	.76389	.73309	.69964	.66452
6.00	.76819	.76534	.75692	.74327	.72492	.70257	.67697	.64893	.61923
6.25	.70242	.70008	.69316	.68190	.66672	.64812	.62668	.60303	.57776
6.50	.64494	.64300	.63726	.62789	.61522	.59961	.58153	.56144	.53985
6.75	.59439	.59277	.58796	.58011	.56943	.55624	.54088	.52373	.50517
7.00	.54969	.54832	.54426	.53761	.52856	.51733	.50421	.48948	.47345
7.25	.50994	.50878	.50533	.49966	.49193	.48232	.47103	.45831	.44441
7.50	.47443	.47344	.47048	.46562	.45898	.45069	.44094	.42990	.41779
7.75	.44257	.44172	.43917	.43498	.42923	.42205	.41357	.40395	.39335
8.00	.41387	.41313	.41092	.40728	.40229	.39604	.38863	.38021	.37089
8.25	.38791	.38726	.38534	.38217	.37781	.37234	.36584	.35843	.35022
8.50	.36435	.36379	.36210	.35932	.35550	.35069	.34497	.33843	.33115
8.75	.34291	.34241	.34093	.33848	.33511	.33087	.32581	.32001	.31355
9.00	.32333	.32289	.32158	.31942	.31644	.31268	.30819	.30303	.29727

TABLE I. - Continued. DIMENSIONLESS AZIMUTHAL MAGNETIC FIELD AT CONSTANT CURRENT DENSITY AS  
FUNCTION OF RADIUS AND AXIAL POSITION

Radius, r/a <sub>1</sub>	Dimensionless azimuthal field $2\pi H_\theta / J_{a1} \sin \psi$ at axial position z/L of -								
	0	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Ratio of half-length to inside radius of coil, L/a <sub>1</sub> , l; ratio of outside to inside radius, a <sub>2</sub> /a <sub>1</sub> , 4									
0.	0.	0.	0.	0.	0.	0.	0.	0.	
.25	-.36787	-.35588	-.31894	-.25663	-.17578	-.09364	-.02696	.01887	.04706
.50	-.75338	-.73042	-.65785	-.52891	-.35248	-.17380	-.03722	.05113	.10328
.75	-.1.17209	-.1.14140	-.1.04091	-.0.84443	-.0.53074	-.0.21446	-.0.0905	.11031	.17682
1.00	-.1.63379	-.1.60163	-.1.49466	-.1.27067	-.0.71072	-.0.14862	-.0.08305	.20705	.27304
1.25	-.72470	-.69793	-.61125	-.44509	-.0.18509	-.0.07582	-.0.024579	.34266	.39250
1.50	-.05803	-.04024	-.01490	-.0.10981	-.0.23569	-.0.36050	-.0.45312	.50749	.53091
1.75	.47088	.47955	.50553	.54727	.59813	.64542	.67713	.68861	.68166
2.00	.92148	.92219	.92420	.92660	.92674	.92045	.90402	.87621	.83836
2.25	1.33095	1.32471	1.30629	1.27651	1.23628	1.18652	1.12859	1.06426	.99585
2.50	1.72472	1.71183	1.67411	1.61430	1.53666	1.44637	1.34884	1.24874	1.14989
2.75	2.12220	2.10229	2.04409	1.95239	1.83505	1.70200	1.56312	1.42628	1.29649
3.00	2.54050	2.51253	2.43064	2.30140	2.13702	1.95403	1.76867	1.59245	1.43114
3.25	2.99657	2.95924	2.84886	2.67239	2.44692	2.20028	1.95977	1.74095	1.54830
3.50	3.50826	3.46086	3.31783	3.08052	2.76809	2.43255	2.12509	1.86232	1.64121
3.75	4.09309	4.03737	3.86427	3.55561	3.10293	2.62601	2.24355	1.94385	1.70261
4.00	4.76393	4.70565	4.52175	4.17433	3.45284	2.70689	2.28507	1.97331	1.72712
4.25	3.99800	3.94485	3.77986	3.48607	3.05583	2.60190	2.23613	1.94781	1.71433
4.50	3.39105	3.34765	3.21683	3.00006	2.71471	2.40723	2.12338	1.87837	1.66997
4.75	2.91130	2.87806	2.77979	2.62269	2.42165	2.20055	1.98288	1.78234	1.60334
5.00	2.52929	2.50442	2.43155	2.31650	2.16968	2.00511	1.83665	1.67436	1.52363
5.25	2.22121	2.20262	2.14830	2.06260	1.95260	1.82718	1.69521	1.56390	1.43805
5.50	1.96919	1.95515	1.91412	1.84914	1.76505	1.66769	1.56306	1.45636	1.35149
5.75	1.76017	1.74943	1.71793	1.66782	1.60239	1.52564	1.44175	1.35451	1.26702
6.00	1.58461	1.57625	1.55169	1.51242	1.46073	1.39941	1.33144	1.25962	1.18639
6.25	1.43547	1.42887	1.40943	1.37820	1.33680	1.28721	1.23160	1.17206	1.11049
6.50	1.30752	1.30223	1.28663	1.26146	1.22788	1.18734	1.14142	1.09171	1.03967
6.75	1.19676	1.19247	1.17979	1.15925	1.13171	1.09823	1.06000	1.01819	.97406
7.00	1.10013	1.09660	1.08618	1.06925	1.04643	1.01853	.98644	.95109	.91341
7.25	1.01523	1.01231	1.00365	.98952	.97048	.94703	.91989	.88979	.85747
7.50	.94019	.93774	.93048	.91863	.90255	.88268	.85958	.83381	.80595
7.75	.87346	.87139	.86526	.85522	.84156	.82462	.80482	.78263	.75849
8.00	.81385	.81209	.80686	.79829	.78660	.77205	.75499	.73578	.71478
8.25	.76033	.75882	.75433	.74697	.73690	.72434	.70955	.69283	.67448
8.50	.71208	.71078	.70690	.70053	.69181	.68090	.66802	.65340	.63729
8.75	.66841	.66728	.66391	.65837	.65077	.64125	.62997	.61713	.60294
9.00	.62874	.62776	.62482	.61998	.61332	.60496	.59505	.58373	.57117
9.25	.59259	.59173	.58915	.58490	.57904	.57168	.56292	.55290	.54175
9.50	.55955	.55879	.55651	.55276	.54758	.54107	.53330	.52440	.51447
9.75	.52925	.52858	.52656	.52324	.51865	.51286	.50595	.49801	.48914
10.00	.50141	.50081	.49902	.49606	.49197	.48681	.48064	.47353	.46558
10.50	.45204	.45156	.45013	.44776	.44449	.44034	.43537	.42964	.42319
11.00	.40974	.40936	.40820	.40628	.40362	.40025	.39620	.39151	.38623
11.50	.37320	.37289	.37194	.37036	.36818	.36541	.36208	.35821	.35384
12.00	.34141	.34115	.34036	.33906	.33726	.33496	.33218	.32896	.32531

Ratio of half-length to inside radius of coil,  $L/a_1$ ,  $l$ ; ratio of outside to inside radius,  $a_2/a_1$ , 5

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	-.40444	-.39200	-.35372	-.28927	-.20562	-.12017	-.04986	-.00024	.03173
.50	-.82722	-.80332	-.72801	-.59470	-.41254	-.22711	-.08312	.01293	.07273
.75	-.128461	-.125246	-.14769	-.94439	-.62179	-.29503	-.07817	.05304	.13130
1.00	-.178723	-.175300	-.164000	-.140640	-.83394	-.25719	-.00958	.13083	.21297
1.25	-.92222	-.89267	-.79787	-.61882	-.34209	-.06170	.12932	.24770	.31854
1.50	-.30394	-.28250	-.21668	-.10488	.04282	.19286	.31252	.39425	.44409
1.75	.17084	.18428	.22417	.28781	.36679	.44633	.51225	.55791	.58352
2.00	.55975	.56668	.58677	.61750	.65378	.68852	.71504	.72949	.73120
2.25	.89758	.89945	.90462	.91163	.91797	.92048	.91634	.90390	.88303
2.50	1.20649	1.20428	1.19753	1.18585	1.16866	1.14526	1.11523	1.07868	1.03634
2.75	1.50158	1.49576	1.47851	1.45044	1.41250	1.36590	1.31207	1.25265	1.18930
3.00	1.79406	1.78469	1.75713	1.71295	1.65461	1.58508	1.50755	1.42512	1.34049
3.25	2.09324	2.08000	2.04123	1.97958	1.89914	1.80492	1.70209	1.59532	1.48841
3.50	2.40798	2.39019	2.33819	2.25596	2.14969	2.02698	1.89552	1.76195	1.63119
3.75	2.74768	2.72425	2.65578	2.54783	2.40943	2.25196	2.08669	1.92276	1.76615
4.00	3.12325	3.09268	3.00309	2.86170	2.68129	2.47925	2.27266	2.07389	1.88952
4.25	3.54788	3.50850	3.39212	3.20601	2.96777	2.70565	2.44736	2.20908	1.99601
4.50	4.03718	3.98801	3.83980	3.59430	3.27104	2.92212	2.59894	2.31862	2.07884
4.75	4.60750	4.55006	4.37196	4.05539	3.59255	3.10308	2.70567	2.38935	2.13049
5.00	5.27121	5.21115	5.02195	4.66599	3.93306	3.17346	2.73640	2.40832	2.14515
5.25	4.49665	4.44165	4.27116	3.96832	3.52573	3.05734	2.67616	2.37184	2.12202
5.50	3.87392	3.82872	3.69259	3.46715	3.17025	2.84921	2.55069	2.29045	2.06654
5.75	3.37481	3.33992	3.23681	3.07188	2.86048	2.62714	2.39606	2.18141	1.98793
6.00	2.97193	2.94561	2.86849	2.74655	2.59062	2.41522	2.23472	2.05959	1.89558
6.25	2.64272	2.62288	2.56485	2.47318	2.35527	2.22033	2.07765	1.93480	1.79688
6.50	2.36999	2.35488	2.31064	2.24051	2.14952	2.04384	1.92974	1.81273	1.69700
6.75	2.14104	2.12936	2.09511	2.04052	1.96911	1.88509	1.79285	1.69645	1.59919
7.00	1.94649	1.93733	1.91040	1.86726	1.81036	1.74266	1.66733	1.58736	1.50537
7.25	1.77942	1.77213	1.75062	1.71603	1.67008	1.61489	1.55278	1.48600	1.41660
7.50	1.63458	1.62869	1.61129	1.58319	1.54562	1.50015	1.44848	1.39233	1.33331
7.75	1.50796	1.50314	1.48889	1.46579	1.43474	1.39691	1.35357	1.30605	1.25562
8.00	1.39646	1.39247	1.38067	1.36147	1.33557	1.30381	1.26718	1.22671	1.18338
8.25	1.29763	1.29430	1.28442	1.26832	1.24651	1.21964	1.18845	1.15377	1.11635
8.50	1.20953	1.20673	1.19839	1.18476	1.16623	1.14332	1.11660	1.08668	1.05429
8.75	1.13057	1.12819	1.12109	1.10947	1.09363	1.07393	1.05092	1.02502	.99677
9.00	1.05946	1.05744	1.05133	1.04137	1.02773	1.01074	.99076	.96821	.94349
9.25	.99521	.99344	.98819	.97956	.96774	.95297	.93556	.91581	.89409
9.50	.93686	.93533	.93076	.92325	.91294	.90005	.88479	.86744	.84828
9.75	.88370	.88236	.87837	.87181	.86279	.85146	.83803	.82271	.80574
10.00	.83512	.83395	.83044	.82467	.81672	.80674	.79487	.78129	.76620
10.50	.74963	.74871	.74597	.74145	.73521	.72134	.71795	.70717	.69512
11.00	.67701	.67628	.67410	.67050	.66552	.65923	.65169	.64301	.63327
11.50	.61472	.61413	.61237	.60947	.60544	.60034	.59422	.58715	.57919
12.00	.56686	.56038	.55894	.55656	.55327	.54909	.54406	.53823	.53166
13.00	.47277	.47244	.47145	.46981	.46753	.46464	.46114	.45708	.45247
14.00	.40423	.40400	.40329	.40212	.40049	.39842	.39591	.39298	.38966
15.00	.34979	.34962	.34911	.34825	.34705	.34552	.34367	.34150	.33903

TABLE I. - Continued. DIMENSIONLESS AZIMUTHAL MAGNETIC FIELD AT CONSTANT CURRENT DENSITY AS  
FUNCTION OF RADIUS AND AXIAL POSITION

Radius, $r/a_1$	Dimensionless azimuthal field $2\pi H_\theta/Ja_1 \sin \psi$ at axial position $z/L$ of -								
	0	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Ratio of half-length to inside radius of coil, $L/a_1$ , 2; ratio of outside to inside radius, $a_2/a_1$ , 1.5									
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	-.07397	-.07685	-.08163	-.06966	-.01325	.04227	.05146	.04157	.03061
.50	-.14675	-.15309	-.16585	-.14953	-.02634	.09511	.10594	.08308	.06067
.75	-.21697	-.22762	-.25387	-.25299	-.03911	.17223	.16508	.12401	.08953
1.00	-.28301	-.29859	-.34372	-.39277	-.05141	.28668	.22729	.16304	.11643
1.25	1.07060	1.05025	.98472	.85877	.64374	.42481	.28653	.19819	.14051
1.50	2.22231	2.19831	2.11706	1.93126	1.23488	.53409	.33434	.22730	.16102
1.75	1.80443	1.77860	1.69057	1.49207	1.03768	.57849	.36484	.24889	.17742
2.00	1.48918	1.46343	1.37743	1.19902	.88809	.57211	.37776	.26255	.18949
2.25	1.24513	1.22100	1.14278	.99397	.77057	.54197	.37685	.26898	.19741
2.50	1.05274	1.03113	.96318	.84247	.67577	.50384	.36684	.26949	.20160
2.75	.89897	.88024	.82280	.72567	.59774	.46467	.35155	.26556	.20263
3.00	.77466	.75877	.71095	.63275	.53249	.42725	.33361	.25854	.20115
3.25	.67313	.65982	.62032	.55710	.47723	.39259	.31469	.24951	.19773
3.50	.58942	.57835	.54580	.49441	.42994	.36096	.29576	.23928	.19290
3.75	.51979	.51061	.48378	.44174	.38913	.33230	.27739	.22845	.18709
4.00	.46137	.45376	.43159	.39698	.35365	.30640	.25989	.21743	.18063
4.25	.41198	.40566	.38727	.35860	.32261	.28301	.24340	.20650	.17380
4.50	.36991	.36464	.34932	.32542	.29532	.26189	.22799	.19584	.16679
Ratio of half-length to inside radius of coil, $L/a_1$ , 2; ratio of outside to inside radius, $a_2/a_1$ , 2									
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	-.14696	-.14913	-.14873	-.11912	-.02968	.05810	.08259	.07399	.05869
.50	-.29288	-.29837	-.30243	-.25186	-.05906	.13046	.17087	.14888	.11695
.75	-.43632	-.44708	-.44647	-.41623	-.08782	.23574	.26921	.22489	.17414
1.00	-.57513	-.59330	-.63576	-.63261	-.11570	.39491	.37845	.30096	.22929
1.25	.70722	.68016	.60377	.51381	.56445	.60746	.49372	.37457	.28106
1.50	1.79083	1.75478	1.664189	1.43879	1.14126	.83497	.60445	.44201	.32790
1.75	2.76859	2.72512	2.58175	2.28132	1.65984	1.02865	.69782	.49935	.36831
2.00	3.68780	3.63979	3.47879	3.12818	2.14279	1.14696	.76369	.54349	.40114
2.25	3.09115	3.04196	2.87832	2.53564	1.86091	1.17524	.79841	.57306	.42581
2.50	2.61670	2.56936	2.41529	2.11512	1.63333	1.14035	.80534	.58855	.44236
2.75	2.23474	2.19134	2.05384	1.80395	1.44580	1.07642	.79169	.59189	.45142
3.00	1.92428	1.88592	1.76738	1.56331	1.28877	1.00316	.76488	.58563	.45396
3.25	1.66985	1.63680	1.53671	1.37089	1.15560	.92957	.73066	.57237	.45115
3.50	1.45973	1.43172	1.34817	1.21326	1.04149	.85943	.69295	.55435	.44414
3.75	1.28489	1.26137	1.19195	1.08180	.94288	.79421	.65421	.53335	.43400
4.00	1.13832	1.11869	1.06117	.97066	.85705	.73430	.61595	.51068	.42162
4.25	1.01456	.99819	.95043	.87568	.78190	.67960	.57903	.48731	.40773
4.50	.90931	.89566	.85589	.79380	.71574	.62981	.54391	.46390	.39292
4.75	.81921	.80779	.77455	.72266	.65722	.58454	.51083	.44089	.37764
5.00	.74157	.73198	.70408	.66047	.60525	.54340	.47985	.41859	.36221
5.25	.67427	.66618	.64264	.60579	.55891	.50598	.45096	.39717	.34690
5.50	.61558	.60873	.58878	.55746	.51744	.47192	.42409	.37674	.33187
5.75	.56412	.55830	.54130	.51455	.48021	.44086	.39914	.35735	.31726
6.00	.51879	.51380	.49926	.47630	.44668	.41253	.37599	.33902	.30315

Ratio of half-length to inside radius of coil,  $L/a_1$ , 2; ratio of outside to inside radius,  $a_2/a_1$ , 3

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	-.26692	-.26469	-.24962	-.19292	-.06674	.05704	.10657	.10997	.09738
.50	-.53441	-.53139	-.50667	-.40146	-.13303	.13060	.22140	.22259	.19521
.75	-.80241	-.80128	-.77736	-.64607	-.19841	.24203	.35165	.33980	.29367
1.00	-.1.06994	-.1.07406	-.1.06490	-.1.95062	-.2.26245	.41611	.50141	.46220	.39241
1.25	.07899	.06622	.04650	.09401	.38217	.65837	.66965	.58871	.49048
1.50	1.02471	1.00056	.94112	.89359	.92429	.94078	.84998	.71652	.58628
1.75	1.86143	1.82426	1.71917	1.56959	1.40922	1.23253	1.03300	.84156	.67774
2.00	2.63901	2.58850	2.43649	2.18597	1.85977	1.51535	1.20880	.95906	.76250
2.25	3.38732	3.32450	3.12859	2.78066	2.28875	1.77696	1.36775	1.06419	.83821
2.50	4.12574	4.05296	3.82058	3.38313	2.70392	2.00349	1.50054	1.15251	.90277
2.75	4.86705	4.78776	4.53107	4.02494	3.11026	2.17337	1.59864	1.22055	.95463
3.00	5.61940	5.53774	5.27264	4.74185	3.51108	2.25750	1.65625	1.26642	.99295
3.25	4.87696	4.79700	4.53973	4.03949	3.15345	2.24437	1.67302	1.29016	1.01772
3.50	4.25528	4.18037	3.94342	3.50672	2.84592	2.16220	1.65490	1.29372	1.02973
3.75	3.73321	3.66551	3.45560	3.08847	2.57919	2.04740	1.61124	1.28043	1.03037
4.00	3.29340	3.23385	3.05269	2.74849	2.34622	1.92222	1.55131	1.25408	1.02139
4.25	2.92156	2.87019	2.71625	2.46511	2.14157	1.79719	1.48238	1.21841	1.00467
4.50	2.60578	2.56201	2.43233	2.22472	1.96086	1.67725	1.40947	1.17650	.98201
4.75	2.33630	2.29928	2.19044	2.01820	1.80062	1.56449	1.33587	1.13088	.95501
5.00	2.01C512	2.07391	1.98259	1.83903	1.65798	1.45962	1.26361	1.08339	.92502
5.25	1.90572	1.87941	1.80268	1.68241	1.53058	1.36266	1.19390	1.03542	.89316
5.50	1.73272	1.71052	1.64591	1.54463	1.41641	1.27336	1.12744	.98790	.86028
5.75	1.58199	1.56321	1.50850	1.42277	1.31381	1.19123	1.06456	.94149	.82706
6.00	1.44984	1.43389	1.38741	1.31446	1.22135	1.11575	1.00537	.89663	.79401
6.25	1.33344	1.31984	1.28018	1.21779	1.13779	1.04640	.94986	.85357	.76149
6.50	1.23043	1.21878	1.18479	1.13117	1.06210	.98264	.89792	.81247	.72977
6.75	1.13886	1.12885	1.09557	1.05327	.99337	.92400	.84939	.77339	.69904
7.00	1.05712	1.04847	1.02314	.98299	.93081	.87000	.80410	.73635	.66942
7.25	.98386	.97635	.95435	.91937	.87373	.82024	.76185	.70132	.64098
7.50	.91796	.91142	.89222	.86162	.82154	.77432	.72243	.66824	.61375
7.75	.85847	.85274	.83592	.80905	.77373	.73190	.68566	.63703	.58776
8.00	.80458	.79955	.78476	.76108	.72983	.69266	.65134	.60760	.56299
8.25	.75562	.75118	.73813	.71717	.68944	.65632	.61930	.57988	.53941
8.50	.71100	.70707	.69551	.67691	.65222	.62261	.58936	.55376	.51699
8.75	.67023	.66674	.65646	.63990	.61785	.59131	.56138	.52916	.49570
9.00	.63287	.62977	.62061	.60580	.58606	.56220	.53519	.50598	.47548

TABLE I. - Continued. DIMENSIONLESS AZIMUTHAL MAGNETIC FIELD AT CONSTANT CURRENT DENSITY AS  
FUNCTION OF RADIUS AND AXIAL POSITION

Radius, $r/a_1$	Dimensionless azimuthal field $2\pi H_\theta/Ja_1 \sin \psi$ at axial position $z/L$ of -								
	0	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Ratio of half-length to inside radius of coil, $L/a_1$ , 2; ratio of outside to inside radius, $a_2/a_1$ , 4									
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	- .35157	- .34591	- .32081	- .24844	- .10322	.03974	.10556	.12070	.11521
.50	- .70496	- .69507	- .65010	- .51317	- .20602	.09658	.22028	.24492	.23157
.75	-1.06148	-1.04996	-1.09527	-1.81532	-1.30795	.19251	.35226	.37554	.34995
1.00	-1.42144	-1.41161	-1.36075	-1.17962	-1.40858	.35309	.50671	.51417	.47074
1.25	- .37017	- .36546	- .33221	- .19794	.19942	.58487	.68395	.66081	.59369
1.50	.47137	.46802	.47288	.53405	.70495	.86133	.87931	.81390	.71790
1.75	1.19626	1.18265	1.15254	1.13575	1.15338	1.15384	1.08566	.97073	.84195
2.00	1.85348	1.82822	1.75984	1.66782	1.56766	1.44768	1.29603	1.12798	.96396
2.25	2.47255	2.43489	2.32681	2.16251	1.96073	1.73657	1.50457	1.28206	1.08183
2.50	3.07331	3.02296	2.87463	2.63902	2.34055	2.01729	1.70632	1.42943	1.19330
2.75	3.67011	3.60722	3.41869	3.11056	2.71232	2.28707	1.89658	1.56644	1.29609
3.00	4.27403	4.19929	3.97163	3.58832	3.07959	2.54195	2.07018	1.68943	1.38797
3.25	4.89384	4.80866	4.54487	4.08409	3.44492	2.77522	2.22103	1.79478	1.46690
3.50	5.53618	5.44291	5.14947	4.61370	3.81008	2.97479	2.34189	1.87901	1.53119
3.75	6.20586	6.10783	5.79572	5.20139	4.17641	3.11903	2.42526	1.93943	1.57966
4.00	6.90569	6.80682	6.49104	5.87934	4.54491	3.17769	2.46565	1.97465	1.61185
4.25	6.11166	6.01599	5.71234	5.13754	4.15376	3.13742	2.46279	1.98512	1.62809
4.50	5.42942	5.34021	5.06101	4.55638	3.80689	3.02539	2.42269	1.97315	1.62949
4.75	4.84330	4.76267	4.51464	4.08639	3.49799	2.87846	2.35507	1.94242	1.61777
5.00	4.33936	4.26822	4.05292	3.69430	3.22195	2.71966	2.26972	1.89719	1.59501
5.25	3.90521	3.84351	3.65926	3.35995	2.97453	2.56057	2.17446	1.84154	1.56340
5.50	3.53009	3.47717	3.32068	3.07060	2.75217	2.40678	2.07486	1.77900	1.52503
5.75	3.20477	3.15968	3.02720	2.81754	2.55185	2.26085	1.97461	1.71241	1.48177
6.00	2.92145	2.88313	2.77100	2.59449	2.37096	2.12383	1.87609	1.64391	1.43524
6.25	2.67359	2.64103	2.54597	2.39667	2.20727	1.99597	1.78075	1.57510	1.38671
6.50	2.45576	2.42804	2.34723	2.22032	2.05882	1.87711	1.68944	1.50710	1.33723
6.75	2.26343	2.23978	2.17082	2.06236	1.92393	1.76683	1.60259	1.44071	1.28759
7.00	2.09287	2.07262	2.01347	1.92049	1.80111	1.66465	1.52044	1.37645	1.23841
7.25	1.94095	1.92354	1.87271	1.79248	1.68907	1.57000	1.44296	1.31464	1.19013
7.50	1.80509	1.79006	1.74612	1.67662	1.58664	1.48234	1.37006	1.25549	1.14309
7.75	1.68311	1.67009	1.63196	1.57148	1.49284	1.40112	1.30159	1.19907	1.09751
8.00	1.57319	1.56185	1.52863	1.47578	1.40677	1.32582	1.23733	1.14542	1.05353
8.25	1.47379	1.46388	1.43480	1.38844	1.32766	1.25596	1.17707	1.09449	1.01125
8.50	1.38361	1.37492	1.34937	1.30853	1.25479	1.19110	1.12057	1.04622	.97071
8.75	1.30155	1.29388	1.27135	1.23525	1.18758	1.13080	1.06759	1.00052	.93192
9.00	1.22664	1.21986	1.19991	1.16789	1.12546	1.07471	1.01791	.95728	.89487
9.25	1.15808	1.15207	1.13435	1.10584	1.06795	1.02246	.97130	.91639	.85952
9.50	1.09517	1.08982	1.07402	1.04856	1.01464	.97375	.92755	.87772	.82583
9.75	1.03730	1.03252	1.01839	.99559	.96512	.92827	.88647	.84117	.79375
10.00	.98394	.97965	.96699	.94650	.91906	.88577	.84786	.80660	.76320
10.50	.88898	.88551	.87523	.85856	.83614	.80878	.77740	.74299	.70649
11.00	.80724	.80440	.79597	.78227	.76377	.74109	.71492	.68602	.65512
11.50	.73637	.73402	.72704	.71568	.70028	.68133	.65933	.63490	.60862
12.00	.67451	.67255	.66673	.65721	.64430	.62833	.60973	.58895	.56648

Ratio of half-length to inside radius of coil,  $L/a_1$ , 2; ratio of outside to inside radius,  $a_2/a_1$ , 5

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	-.41124	-.40358	-.37271	-.29153	-.13560	.01860	.09488	.11879	.11999
.50	-.82508	-.81113	-.75449	-.59971	-.27087	.05444	.19924	.24151	.24151
.75	-.124358	-.122586	-.115331	-.94604	-.40547	.12969	.32153	.37145	.36587
1.00	-.166788	-.164958	-.157426	-.135565	-.53904	.27012	.46737	.51068	.49385
1.25	-.68418	-.66854	-.60369	-.42082	.03567	.48254	.63752	.65972	.62566
1.50	.08563	.09584	.14015	.26227	.50750	.74075	.82789	.81759	.76093
1.75	.73359	.73642	.75436	.81245	.92179	1.01663	1.03210	.98229	.89873
2.00	1.30756	1.30182	1.29093	1.28966	1.30146	1.29611	1.24408	1.15133	1.03781
2.25	1.83593	1.82096	1.78061	1.72518	1.65945	1.57384	1.45925	1.32216	1.17668
2.50	2.33732	2.31275	2.24283	2.13685	2.00380	1.84809	1.67432	1.49234	1.31373
2.75	2.82501	2.79059	2.69088	2.53587	2.33977	2.11827	1.88684	1.65963	1.44724
3.00	3.30922	3.26468	3.13453	2.93004	2.67111	2.38403	2.09466	1.82182	1.57552
3.25	3.79829	3.74331	3.58164	3.32544	3.00046	2.64475	2.29561	1.97662	1.69676
3.50	4.29938	4.23371	4.03916	3.72741	3.32986	2.89922	2.48710	2.12158	1.80911
3.75	4.81886	4.74244	4.51383	4.14141	3.66090	3.14523	2.66581	2.25393	1.91067
4.00	5.36259	5.27579	5.01278	4.57386	3.99482	3.37883	2.82731	2.37062	1.99954
4.25	5.93553	5.83943	5.54390	5.03367	4.33254	3.59308	2.96579	2.46834	2.07392
4.50	6.54208	6.43874	6.11602	5.53487	4.67479	3.77542	3.07425	2.54385	2.13228
4.75	7.18510	7.07763	6.73798	6.10066	5.02207	3.90369	3.14479	2.59449	2.17357
5.00	7.86613	7.75835	7.41635	6.76302	5.37473	3.94663	3.17162	2.61884	2.19741
5.25	7.05146	6.94732	6.61866	6.00360	4.96625	3.88951	3.15412	2.61732	2.20420
5.50	6.34049	6.24329	5.94046	5.39752	4.59737	3.75865	3.09808	2.59226	2.19513
5.75	5.72095	5.63285	5.36273	4.89881	4.26357	3.59099	3.01323	2.54741	2.17201
6.00	5.18125	5.10317	4.86751	4.47610	3.96100	3.41003	2.90955	2.48716	2.13706
6.25	4.71053	4.64251	4.43961	4.11048	3.68628	3.22793	2.79520	2.41578	2.09260
6.50	4.29904	4.24038	4.06699	3.78993	3.43647	3.05073	2.67601	2.33702	2.04089
6.75	3.93823	3.88794	3.74021	3.50626	3.20897	2.88140	2.55598	2.25388	1.98393
7.00	3.62072	3.57772	3.45187	3.25352	3.00152	2.72125	2.43764	2.16871	1.92347
7.25	3.34016	3.30340	3.19602	3.02709	2.81204	2.57072	2.32281	2.08326	1.86092
7.50	3.09124	3.05977	2.96789	2.82334	2.63872	2.42981	2.21230	1.99878	1.79743
7.75	2.86949	2.84246	2.76357	2.63930	2.47996	2.29815	2.10673	1.91617	1.73390
8.00	2.67113	2.64785	2.57984	2.47251	2.33430	2.17544	2.00637	1.83602	1.67099
8.25	2.49301	2.47289	2.41402	2.32089	2.20044	2.06104	1.91128	1.75873	1.60927
8.50	2.33247	2.31498	2.26382	2.18262	2.07725	1.95444	1.82139	1.68452	1.54905
8.75	2.18725	2.17196	2.12735	2.05634	1.96369	1.85511	1.73655	1.61355	1.49062
9.00	2.05546	2.04212	2.00297	1.94058	1.85885	1.76250	1.65660	1.54582	1.43415
9.25	1.93547	1.92374	1.88930	1.83427	1.76188	1.67616	1.58128	1.48131	1.37976
9.50	1.82589	1.81554	1.78512	1.73640	1.67211	1.59556	1.51035	1.41996	1.32748
9.75	1.72557	1.71641	1.68944	1.64615	1.58882	1.52027	1.44356	1.36168	1.27735
10.00	1.63345	1.62531	1.60132	1.56272	1.51145	1.44990	1.38067	1.30636	1.22935
10.50	1.47042	1.46392	1.44475	1.41379	1.37242	1.32238	1.26561	1.20406	1.13958
11.00	1.33104	1.32579	1.31028	1.28514	1.25140	1.21033	1.16337	1.11202	1.05773
11.50	1.21088	1.20660	1.19391	1.17329	1.14549	1.11147	1.07232	1.02919	.98321
12.00	1.10654	1.10300	1.09252	1.07544	1.05232	1.02391	.99102	.95456	.91542
13.00	.93506	.93259	.92524	.91322	.89685	.87658	.85290	.82636	.79755
14.00	.80099	.79920	.79389	.78517	.77326	.75841	.74094	.72120	.69957
15.00	.69410	.69277	.68883	.68236	.67346	.66233	.64917	.63420	.61768

TABLE I. - Continued. DIMENSIONLESS AZIMUTHAL MAGNETIC FIELD AT CONSTANT CURRENT DENSITY AS  
FUNCTION OF RADIUS AND AXIAL POSITION

Radius, $r/a_1$	Dimensionless azimuthal field $2\pi H_\theta/Ja_1 \sin \psi$ at axial position $z/L$ of -								
	0	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Ratio of half-length to inside radius of coil, $L/a_1$ , 3; ratio of outside to inside radius, $a_2/a_1$ , 1.5									
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	-.04249	-.04681	-.05984	-.06925	-.00637	.05598	.04488	.02854	.01831
.50	-.08429	-.09285	-.11946	-.14493	-.01271	.11848	.08967	.05651	.03627
.75	-.12468	-.13734	-.17816	-.23249	-.01896	.19306	.13380	.08335	.05356
1.00	-.16304	-.17945	-.23447	-.33252	-.02508	.28038	.17592	.10842	.06986
1.25	1.21493	1.19530	1.12746	.97937	.67581	.36985	.21401	.13111	.08488
1.50	2.38656	2.36445	2.28672	2.09981	1.27218	.44177	.24590	.15087	.09840
1.75	1.98336	1.95965	1.87611	1.67359	1.07963	.48257	.27006	.16734	.11025
2.00	1.67732	1.65292	1.56786	1.37077	.93408	.49402	.28609	.18035	.12034
2.25	1.43732	1.41309	1.33019	1.15039	.81997	.48596	.29466	.18996	.12864
2.50	1.24458	1.22121	1.14310	.98474	.72796	.46742	.29707	.19642	.13520
2.75	1.08695	1.06501	.99321	.85623	.65211	.44413	.29481	.20010	.14012
3.00	.95638	.93608	.87133	.75374	.58848	.41927	.28921	.20142	.14355
3.25	.84690	.82844	.77076	.67013	.53429	.39449	.28137	.20084	.14564
3.50	.75430	.73771	.68677	.60065	.48761	.37062	.27212	.19873	.14659
3.75	.67535	.66058	.61584	.54202	.44698	.34805	.26206	.19546	.14655
4.00	.60759	.59451	.55536	.49192	.41132	.32691	.25160	.19131	.14569
4.25	.54907	.53754	.50333	.44865	.37980	.30722	.24106	.18654	.14415
4.50	.49824	.48810	.45823	.41097	.35175	.28895	.23062	.18134	.14208
Ratio of half-length to inside radius of coil, $L/a_1$ , 3; ratio of outside to inside radius, $a_2/a_1$ , 2									
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	-.09142	-.09812	-.11574	-.11815	-.01479	.08745	.08147	.05704	.03876
.50	-.18170	-.19521	-.23203	-.24609	-.02950	.18489	.16377	.11345	.07698
.75	-.26972	-.29016	-.34876	-.39322	-.04402	.30193	.24702	.16849	.11411
1.00	-.35435	-.38170	-.46456	-.56495	-.05828	.44414	.33011	.22125	.14961
1.25	.97923	.94529	.83712	.65830	.63467	.60586	.41044	.27069	.18294
1.50	2.10890	2.06907	1.93709	1.67275	1.22332	.76787	.48425	.31569	.21362
1.75	3.12527	3.08071	2.92930	2.59315	1.75261	.90531	.54754	.35520	.24122
2.00	4.07390	4.02607	3.86189	3.48462	2.24506	.99808	.59718	.38846	.26543
2.25	3.49663	3.44718	3.27781	2.89513	1.97139	1.03971	.63177	.41501	.28606
2.50	3.03169	2.98221	2.81477	2.45385	1.75071	1.03922	.65178	.43484	.30304
2.75	2.65041	2.60231	2.44238	2.11704	1.56878	1.01186	.65910	.44831	.31646
3.00	2.33342	2.28776	2.13903	1.85308	1.41610	.97025	.65631	.45605	.32648
3.25	2.06702	2.02452	1.88896	1.64084	1.28607	.92233	.64600	.45885	.33339
3.50	1.84116	1.80217	1.68043	1.46640	1.17401	.87263	.63044	.45754	.33749
3.75	1.64825	1.61305	1.50472	1.32041	1.07644	.82355	.61140	.45293	.33914
4.00	1.48244	1.45090	1.35520	1.19643	.99077	.77633	.59026	.44575	.33869
4.25	1.33909	1.31103	1.22685	1.08986	.91501	.73156	.56797	.43662	.33646
4.50	1.21451	1.18966	1.1580	.99733	.84758	.68948	.54525	.42608	.33278
4.75	1.10571	1.08378	1.01905	.91631	.78724	.65012	.52259	.41455	.32792
5.00	1.01025	.99093	.93421	.84485	.73300	.61340	.50030	.40237	.32212
5.25	.92613	.90912	.85939	.78145	.68403	.57920	.47861	.38981	.31560
5.50	.85170	.83673	.79307	.72488	.63966	.54738	.45766	.37709	.30854
5.75	.78558	.77240	.73401	.67418	.59933	.51777	.43753	.36436	.30108
6.00	.72663	.71501	.68119	.62852	.56254	.49021	.41827	.35175	.29335

Ratio of half-length to inside radius of coil,  $L/a_1$ , 3; ratio of outside to inside radius,  $a_2/a_1$ , 3

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	-.18955	-.19592	-.20809	-.18719	-.03609	.11284	.12692	.10243	.07703
.50	-.37795	-.39117	-.41824	-.38655	-.07199	.23824	.25636	.20475	.15354
.75	-.56401	-.58488	-.63180	-.61027	-.10754	.38876	.39011	.30667	.22898
1.00	-.74639	-.77593	-.84881	-.86738	-.14256	.57378	.52866	.40762	.30273
1.25	.49009	.45095	.34609	.25663	.52997	.79290	.67079	.50661	.37410
1.50	1.52386	1.47450	1.33309	1.15091	1.09863	1.03414	.81358	.60232	.44234
1.75	2.44637	2.38664	2.20651	1.92169	1.60845	1.28132	.95285	.69313	.50666
2.00	3.30412	3.23452	3.01643	2.62840	2.08200	1.52019	1.08374	.77726	.56628
2.25	4.12356	4.04524	3.79301	3.30858	2.53187	1.73841	1.20133	.85298	.62047
2.50	4.92099	4.83572	4.55604	3.98997	2.96564	1.92341	1.30111	.91879	.66865
2.75	5.70686	5.61683	5.31872	4.69621	3.38816	2.06124	1.37955	.97355	.71033
3.00	6.48810	6.39575	6.08952	5.44600	3.80264	2.13970	1.43474	1.01666	.74526
3.25	5.75886	5.66664	5.36248	4.73564	3.45618	2.15660	1.46669	1.04808	.77340
3.50	5.13598	5.04607	4.75282	4.17056	3.15737	2.12368	1.47735	1.06830	.79490
3.75	4.6041	4.51461	4.23878	3.71470	2.89698	2.05857	1.47006	1.07829	.81009
4.00	4.13739	4.05699	3.80261	3.33944	2.66809	1.97609	1.44867	1.07927	.81945
4.25	3.73530	3.66109	3.42998	3.02454	2.46545	1.88588	1.41690	1.07264	.82355
4.50	3.38465	3.31698	3.10930	2.75593	2.28490	1.79370	1.37794	1.05979	.82302
4.75	3.07769	3.01658	2.83139	2.52382	2.12316	1.70277	1.33433	1.04200	.81849
5.00	2.80799	2.75320	2.58890	2.32109	1.97758	1.61486	1.28803	1.02043	.81058
5.25	2.57020	2.52133	2.37604	2.14252	1.84601	1.53094	1.24045	.99608	.79988
5.50	2.35979	2.31635	2.18809	1.98407	1.72667	1.45136	1.19263	.96975	.78691
5.75	2.17302	2.13451	2.02135	1.84267	1.61806	1.37629	1.14529	.94215	.77214
6.00	2.00664	1.97253	1.87267	1.71581	1.51893	1.30566	1.09893	.91377	.75600
6.25	1.85794	1.82774	1.73955	1.60148	1.42821	1.23933	1.05390	.88506	.73881
6.50	1.72463	1.69787	1.61990	1.49804	1.34499	1.17711	1.01039	.85636	.72090
6.75	1.60474	1.58101	1.51196	1.40413	1.26847	1.11878	.96855	.82792	.70251
7.00	1.49659	1.47553	1.41426	1.31860	1.19798	1.06410	.92846	.79992	.68384
7.25	1.39876	1.38003	1.32556	1.24048	1.13291	1.01284	.89010	.77253	.66507
7.50	1.31000	1.29332	1.24480	1.16893	1.07273	.96477	.85350	.74583	.64635
7.75	1.22927	1.21439	1.17107	1.10324	1.01699	.91969	.81861	.71990	.62777
8.00	1.15565	1.14234	1.10358	1.04280	.96528	.87735	.78539	.69479	.60944
8.25	1.08834	1.07641	1.04166	.98707	.91723	.83761	.75379	.67054	.59142
8.50	1.02666	1.01595	.98472	.93558	.87249	.80026	.72373	.64715	.57377
8.75	.97001	.96037	.93225	.88790	.83081	.76515	.69516	.62463	.55653
9.00	.91787	.90917	.88379	.84369	.79192	.73210	.66800	.60297	.53973

TABLE I. - Continued. DIMENSIONLESS AZIMUTHAL MAGNETIC FIELD AT CONSTANT CURRENT DENSITY AS  
 FUNCTION OF RADIUS AND AXIAL POSITION

Radius, $r/a_1$	Dimensionless azimuthal field $2\pi H_0/Ja_1 \sin \psi$ at axial position $z/L$ of -								
	0	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Ratio of half-length to inside radius of coil, $L/a_1$ , 3; ratio of outside to inside radius, $a_2/a_1$ , 4									
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	- .27375	- .27718	- .27920	- .23876	- .06057	.11483	.14669	.12992	.10544
.50	- .54682	- .55427	- .56127	- .49041	- .12091	.24300	.29676	.26029	.21062
.75	- .81845	- .83100	- .84840	- .76785	- .18079	.39795	.45294	.39139	.31524
1.00	- 1.08771	- 1.10678	- 1.14157	- 1.08106	- .23998	.59007	.61670	.52319	.41890
1.25	.0629	.03316	- .02638	- .01670	.40860	.82024	.78788	.65524	.52110
1.50	1.00379	.96715	.87623	.81276	.95359	1.07821	.96479	.78668	.62119
1.75	1.83420	1.78682	1.65937	1.51125	1.44008	1.35024	1.14459	.91625	.71845
2.00	2.59820	2.53926	2.37189	2.13481	1.89070	1.62562	1.32379	1.04247	.81202
2.25	3.32266	3.25179	3.04286	2.71585	2.31810	1.89724	1.49874	1.16353	.90100
2.50	4.02451	3.94184	3.69140	3.27477	2.72995	2.16005	1.66573	1.27762	.98446
2.75	4.71518	4.62138	4.33115	3.82594	3.13114	2.40948	1.82104	1.38288	1.06151
3.00	5.40275	5.29904	4.97256	4.38135	3.52498	2.64021	1.96091	1.47756	1.13132
3.25	6.09318	5.98128	5.62413	4.95290	3.91382	2.84502	2.08161	1.56007	1.19319
3.50	6.79067	6.67278	6.29262	5.55400	4.29928	3.01377	2.17966	1.62915	1.24657
3.75	7.49832	7.37695	6.98332	6.20022	4.68259	3.13337	2.25232	1.68397	1.29114
4.00	8.21815	8.09597	7.69943	6.90582	5.06468	3.19142	2.29818	1.72421	1.32676
4.25	7.42667	7.30626	6.91727	6.15023	4.68391	3.18518	2.31769	1.75013	1.35357
4.50	6.73101	6.61468	6.24221	5.52979	4.34420	3.12612	2.31320	1.76256	1.37190
4.75	6.11798	6.00756	5.65825	5.01425	4.03942	3.03226	2.28844	1.76274	1.38228
5.00	5.57655	5.47336	5.15123	4.57831	3.76464	2.91912	2.24771	1.75222	1.38537
5.25	5.09730	5.00211	4.70887	4.20353	3.51600	2.79709	2.19518	1.73268	1.38194
5.50	4.67218	4.58529	4.32089	3.87693	3.29008	2.67256	2.13445	1.70579	1.37281
5.75	4.29422	4.21556	3.97877	3.58923	3.08417	2.54931	2.06846	1.67311	1.35879
6.00	3.95738	3.88663	3.67552	3.33363	2.89597	2.42947	1.99946	1.63603	1.34067
6.25	3.65646	3.59310	3.40540	3.10500	2.72351	2.31425	1.92912	1.59573	1.31918
6.50	3.38693	3.33037	3.16365	2.89929	2.56510	2.20426	1.85872	1.55324	1.29500
6.75	3.14488	3.09440	2.94662	2.71336	2.41930	2.09976	1.78912	1.50935	1.26870
7.00	2.92694	2.88207	2.75083	2.54461	2.28484	2.00077	1.72094	1.46475	1.24082
7.25	2.73018	2.69024	2.57366	2.39091	2.16059	1.90720	1.65461	1.41995	1.21180
7.50	2.55206	2.51649	2.41280	2.25049	2.04564	1.81887	1.59042	1.37536	1.18201
7.75	2.39046	2.35875	2.26638	2.12184	1.93906	1.73556	1.52854	1.33131	1.15177
8.00	2.24340	2.21510	2.13268	2.00366	1.84013	1.65700	1.46906	1.28804	1.12136
8.25	2.10928	2.08398	2.01030	1.89486	1.74815	1.58296	1.41203	1.24573	1.09099
8.50	1.98666	1.96400	1.89800	1.79447	1.66252	1.51316	1.35743	1.20451	1.06080
8.75	1.87429	1.85396	1.79472	1.70166	1.58269	1.44735	1.30523	1.16448	1.03099
9.00	1.77109	1.75281	1.69953	1.61570	1.50819	1.38529	1.25538	1.12570	1.00165
9.25	1.67610	1.65964	1.61161	1.53592	1.43856	1.32674	1.20780	1.08820	.97287
9.50	1.58849	1.57364	1.53026	1.46178	1.37342	1.27148	1.16242	1.05201	.94471
9.75	1.50753	1.49410	1.45484	1.39275	1.31240	1.21930	1.11915	1.01709	.91724
10.00	1.43257	1.42040	1.38479	1.32838	1.25517	1.17001	1.07791	.98348	.89048
10.50	1.29842	1.28837	1.25891	1.21208	1.15097	1.07933	1.00111	.92003	.83921
11.00	1.18220	1.17384	1.14928	1.11012	1.05874	.99810	.93133	.86142	.79099
11.50	1.08088	1.07387	1.05326	1.02029	.97680	.92517	.86788	.80737	.74581
12.00	.99205	.98613	.96869	.94073	.90373	.85952	.81013	.75754	.70358

Ratio of half-length to inside radius of coil,  $L/a_1$ , 3; ratio of outside to inside radius,  $a_2/a_1$ , 5

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	- .34098	- .34159	- .33512	- .28093	- .08564	.10671	.15205	.14384	.12349
.50	- .68175	- .68358	- .67357	- .57502	- .17103	.22708	.30791	.28850	.24698
.75	-1.02201	-1.02616	-1.01800	- .89553	- .25592	.37485	.47075	.43465	.37040
1.00	-1.36129	-1.36923	-1.36987	-1.25273	- .34009	.56080	.64250	.58264	.49364
1.25	- .28515	- .29850	- .31533	- .23370	.28358	.78621	.82356	.73245	.61641
1.50	.58424	.56386	.52408	.54860	.80374	1.04136	1.01284	.88362	.73832
1.75	1.33788	1.30901	1.24079	1.19751	1.26552	1.31318	1.20817	1.03538	.85884
2.00	2.02215	1.98355	1.88290	1.76825	1.69159	1.59182	1.40694	1.18662	.97732
2.25	2.66364	2.61439	2.47846	2.29210	2.09464	1.87138	1.60646	1.33608	1.09297
2.50	3.27917	3.21859	3.04562	2.78788	2.48237	2.14849	1.80417	1.48231	1.20504
2.75	3.88018	3.80790	3.59678	3.26769	2.85974	2.42098	1.99769	1.62383	1.31254
3.00	4.47502	4.39090	4.14115	3.74004	3.23013	2.68711	2.18466	1.75906	1.41460
3.25	5.07005	4.97427	4.68598	4.21151	3.59592	2.94511	2.36270	1.88642	1.51028
3.50	5.67034	5.56339	5.23742	4.68794	3.95880	3.19260	2.52924	2.00427	1.59870
3.75	6.27995	6.16272	5.80098	5.17515	4.32011	3.42634	2.68142	2.11102	1.67897
4.00	6.90229	6.77609	6.38196	5.67998	4.68083	3.64158	2.81609	2.20514	1.75039
4.25	7.53991	7.4C648	6.98519	6.21089	5.04170	3.83126	2.92991	2.28524	1.81233
4.50	8.19486	8.05638	7.61523	6.77941	5.40332	3.98513	3.01961	2.35023	1.86432
4.75	8.86845	8.72742	8.27566	7.39991	5.76612	4.08967	3.08247	2.39940	1.90614
5.00	9.56151	9.42057	8.96859	8.08610	6.13047	4.13190	3.11711	2.43254	1.93775
5.25	8.74069	8.60245	8.16067	7.30850	5.72993	4.10839	3.12397	2.45002	1.95937
5.50	8.0C699	7.87374	7.45124	6.65785	5.36537	4.03018	3.10541	2.45276	1.97144
5.75	7.35066	7.22430	6.82778	6.10743	5.03249	3.91531	3.06527	2.44213	1.97458
6.00	6.76308	6.64492	6.27851	5.63422	4.72768	3.77962	3.00800	2.41981	1.96956
6.25	6.23650	6.12732	5.79279	5.22117	4.44786	3.63394	2.93800	2.38764	1.95726
6.50	5.76399	5.66410	5.36138	4.85617	4.19041	3.48511	2.85908	2.34742	1.93859
6.75	5.33939	5.24870	4.97649	4.53056	3.95306	3.33722	2.77439	2.30087	1.91450
7.00	4.95725	4.87539	4.63164	4.23796	3.73376	3.19271	2.68641	2.24951	1.88585
7.25	4.61262	4.53904	4.32135	3.97342	3.53100	3.05302	2.59700	2.19466	1.85348
7.50	4.30120	4.23524	4.04109	3.73311	3.34305	2.91891	2.50754	2.13744	1.81815
7.75	4.01918	3.96016	3.78708	3.51394	3.16865	2.79078	2.41903	2.07880	1.78053
8.00	3.76322	3.71046	3.55613	3.31337	3.00657	2.66875	2.33221	2.01946	1.74121
8.25	3.53039	3.48321	3.34538	3.12924	2.85577	2.55280	2.24756	1.96002	1.70070
8.50	3.31810	3.27582	3.15282	2.95980	2.71528	2.44278	2.16548	1.90096	1.65944
8.75	3.12412	3.08633	2.97620	2.80349	2.58425	2.33849	2.08612	1.84266	1.61779
9.00	2.94646	2.91259	2.81387	2.65899	2.46186	2.23973	2.00963	1.78539	1.57606
9.25	2.78340	2.75299	2.66434	2.52512	2.34749	2.14620	1.93608	1.72938	1.53450
9.50	2.63340	2.60605	2.52632	2.40093	2.24044	2.05765	1.86547	1.67476	1.49332
9.75	2.49518	2.47054	2.39865	2.28545	2.14014	1.97383	1.79777	1.62167	1.45268
10.00	2.36751	2.34527	2.28034	2.17794	2.04608	1.89445	1.73293	1.57016	1.41271
10.50	2.13987	2.12164	2.06835	1.98402	1.87479	1.74808	1.61153	1.47207	1.33520
11.00	1.94355	1.92850	1.88442	1.81443	1.72325	1.61662	1.50055	1.38059	1.26136
11.50	1.773C9	1.76057	1.72384	1.66531	1.58866	1.49836	1.39917	1.29559	1.19147
12.00	1.62418	1.61368	1.58285	1.53356	1.46869	1.39177	1.30659	1.21680	1.12565
13.00	1.37771	1.37019	1.34802	1.31239	1.26508	1.20834	1.14464	1.07643	1.00594
14.00	1.18355	1.17802	1.16170	1.13533	1.10007	1.05740	1.00892	.95634	.90126
15.00	1.02787	1.02372	1.01143	.99151	.96473	.93205	.89459	.85353	.81001

TABLE I. - Continued. DIMENSIONLESS AZIMUTHAL MAGNETIC FIELD AT CONSTANT CURRENT DENSITY AS  
FUNCTION OF RADIUS AND AXIAL POSITION

Radius, $r/a_1$	Dimensionless azimuthal field $2\pi H_\theta/Ja_1 \sin \psi$ at axial position $z/L$ of -								
	0	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Ratio of half-length to inside radius of coil, $L/a_1$ , 5; ratio of outside to inside radius, $a_2/a_1$ , 1.5									
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	- .01784	- .02070	- .03197	- .05853	- .00239	.05352	.02625	.01351	.00784
.50	- .03553	- .04117	- .06342	- .11791	- .00478	.10791	.05199	.02683	.01561
.75	- .05290	- .06117	- .09383	- .17811	- .00716	.16315	.07674	.03977	.02322
1.00	- .06981	- .08051	- .12267	- .23743	- .00952	.21754	.09998	.05214	.03060
1.25	1.32759	1.31473	1.26426	1.12133	.69501	.26764	.12126	.06381	.03770
1.50	2.51627	2.50155	2.44421	2.27911	1.29485	.30934	.14017	.07463	.04444
1.75	2.12746	2.11125	2.04866	1.86999	1.10558	.33975	.15643	.08450	.05079
2.00	1.83306	1.81569	1.74953	1.56627	.96310	.35836	.16990	.09336	.05669
2.25	1.60194	1.58376	1.51566	1.33527	.85185	.36669	.18060	.10116	.06214
2.50	1.41545	1.39681	1.32821	1.15585	.76245	.36717	.18867	.10791	.06710
2.75	1.26168	1.24288	1.17504	1.01375	.68897	.36219	.19434	.11362	.07156
3.00	1.13275	1.11406	1.04798	.89911	.62746	.35369	.19791	.11833	.07554
3.25	1.02311	1.00476	.94120	.80503	.57516	.34307	.19969	.12212	.07903
3.50	.92883	.91101	.85048	.72664	.53012	.33129	.19998	.12504	.08205
3.75	.84698	.82983	.77267	.66043	.49090	.31898	.19906	.12718	.08463
4.00	.77536	.75899	.70537	.60382	.45642	.30656	.19717	.12862	.08678
4.25	.71227	.69675	.64672	.55492	.42585	.29430	.19453	.12944	.08853
4.50	.65638	.64174	.59526	.51226	.39857	.28235	.19131	.12973	.08991
Ratio of half-length to inside radius of coil, $L/a_1$ , 5; ratio of outside to inside radius, $a_2/a_1$ , 2									
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	- .04087	- .04662	- .06766	- .10630	- .00567	.09445	.05417	.02983	.01786
.50	- .08141	- .09280	- .13460	- .21510	- .01133	.19144	.10767	.05930	.03556
.75	- .12131	- .13810	- .20006	- .32780	- .01697	.29239	.15978	.08806	.05294
1.00	- .16026	- .18213	- .26319	- .44360	- .02255	.39654	.20972	.11578	.06986
1.25	1.21574	1.18924	1.09060	.85494	.67877	.50019	.25663	.14216	.08618
1.50	2.38379	2.35318	2.23903	1.95092	1.27545	.59714	.29969	.16690	.10176
1.75	3.43386	3.39976	3.27264	2.94114	1.81237	.68034	.33814	.18978	.11651
2.00	4.41104	4.37410	4.23697	3.87603	2.31199	.74429	.37141	.21061	.13033
2.25	3.85687	3.81777	3.67373	3.29927	2.04502	.78672	.39916	.22927	.14316
2.50	3.40956	3.36899	3.22113	2.84782	1.83052	.80886	.42138	.24569	.15493
2.75	3.04064	2.99921	2.85044	2.48947	1.65423	.81432	.43822	.25985	.16562
3.00	2.73109	2.68950	2.54223	2.20092	1.50663	.80740	.45012	.27181	.17521
3.25	2.46772	2.42646	2.28280	1.96510	1.38114	.79201	.45760	.28164	.18372
3.50	2.24108	2.20062	2.06215	1.76954	1.27307	.77121	.46126	.28949	.19117
3.75	2.04419	2.00491	1.87278	1.60514	1.17895	.74721	.46171	.29548	.19758
4.00	1.87180	1.83399	1.70894	1.46521	1.09622	.72152	.45952	.29980	.20300
4.25	1.71983	1.68372	1.56616	1.34477	1.02289	.69519	.45521	.30260	.20749
4.50	1.58510	1.55083	1.44091	1.24007	.95742	.66886	.44922	.30406	.21111
4.75	1.46505	1.43271	1.33037	1.14826	.89860	.64297	.44193	.30435	.21391
5.00	1.35761	1.32723	1.23228	1.06713	.84546	.61779	.43367	.30361	.21597
5.25	1.26107	1.23264	1.14479	.99494	.79721	.59348	.42468	.30200	.21735
5.50	1.17403	1.14752	1.06639	.93032	.75321	.57012	.41520	.29964	.21810
5.75	1.09529	1.07063	.99583	.87213	.71292	.54775	.40538	.29665	.21831
6.00	1.02386	1.00098	.93207	.81951	.67590	.52638	.39536	.29313	.21801

Ratio of half-length to inside radius of coil,  $L/a_1$ , 5; ratio of outside to inside radius,  $a_2/a_1$ , 3

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	- .09658	- .10642	- .13777	- .17509	- .01461	.14470	.10356	.06472	.04153
.50	- .19258	- .21219	- .27503	- .35473	- .02918	.29403	.20671	.12896	.08279
.75	- .28743	- .31665	- .41117	- .54249	- .04368	.45163	.30895	.19222	.12348
1.00	- .38059	- .41914	- .54540	- .73985	- .05808	.61905	.40959	.25402	.16335
1.25	.94221	.89471	.73702	.46836	.63451	.79494	.50773	.31386	.20213
1.50	2.05832	2.00237	1.81414	1.46327	1.22255	.97506	.60223	.37125	.23958
1.75	3.05797	2.99424	2.77711	2.34090	1.75095	1.15322	.69181	.42572	.27546
2.00	3.98647	3.91574	3.67224	3.15326	2.24218	1.32236	.77511	.47683	.30957
2.25	4.86912	4.79232	4.52583	3.93239	2.70872	1.47541	.85085	.52418	.34172
2.50	5.72125	5.63941	5.35406	4.69999	3.15811	1.60575	.91790	.56744	.37176
2.75	6.55258	6.46681	6.16732	5.47102	3.59509	1.70792	.97543	.60638	.39957
3.00	7.36967	7.28112	6.97249	6.25516	4.02290	1.77867	1.02296	.64083	.42507
3.25	6.66665	6.57646	6.26369	5.54644	3.68851	1.81800	1.06044	.67073	.44819
3.50	6.06066	5.96994	5.65772	4.95873	3.40053	1.82920	1.08819	.69611	.46891
3.75	5.53327	5.44304	5.13556	4.46820	3.14976	1.81768	1.10685	.71711	.48726
4.00	5.07058	4.98175	4.68252	4.05518	2.92927	1.78936	1.11731	.73390	.50327
4.25	4.66195	4.57531	4.28709	3.70386	2.73385	1.74949	1.12058	.74674	.51701
4.50	4.29896	4.21515	3.93995	3.40189	2.55936	1.70220	1.11772	.75593	.52857
4.75	3.97492	3.89443	3.63361	3.13976	2.40258	1.65057	1.10975	.76179	.53805
5.00	3.68440	3.60762	3.36194	2.91011	2.26091	1.59674	1.09763	.76465	.54559
5.25	3.42297	3.35013	3.11987	2.70728	2.13226	1.54218	1.08218	.76485	.55130
5.50	3.18690	3.11814	2.90319	2.52682	2.01491	1.48790	1.06416	.76271	.55534
5.75	2.97310	2.90846	2.70850	2.36526	1.90743	1.43456	1.04417	.75853	.55782
6.00	2.77893	2.71838	2.53282	2.21975	1.80865	1.38259	1.02273	.75261	.55890
6.25	2.60214	2.54558	2.37374	2.08804	1.71756	1.33225	1.00027	.74521	.55871
6.50	2.44078	2.38809	2.22918	1.96828	1.63332	1.28369	.97714	.73655	.55737
6.75	2.29318	2.24420	2.09740	1.85895	1.55520	1.23699	.95362	.72686	.55600
7.00	2.15790	2.11242	1.97692	1.75877	1.48259	1.19217	.92993	.71630	.55173
7.25	2.03364	1.99148	1.86645	1.66667	1.41494	1.14923	.90626	.70509	.54767
7.50	1.91930	1.88025	1.76491	1.58175	1.35180	1.10812	.88274	.69332	.54290
7.75	1.81390	1.77774	1.67135	1.50324	1.29271	1.06880	.85949	.68113	.53753
8.00	1.71656	1.68310	1.58494	1.43049	1.23737	1.03119	.83660	.66863	.53164
8.25	1.62651	1.59556	1.50499	1.36287	1.18543	.99525	.81413	.65593	.52530
8.50	1.54308	1.51447	1.43080	1.29994	1.13661	.96089	.79213	.64308	.51858
8.75	1.46566	1.43917	1.36190	1.24124	1.09067	.92804	.77064	.63017	.51155
9.00	1.39371	1.36919	1.29776	1.18640	1.04737	.89665	.74967	.61726	.50426

TABLE I. - Continued. DIMENSIONLESS AZIMUTHAL MAGNETIC FIELD AT CONSTANT CURRENT DENSITY AS  
FUNCTION OF RADIUS AND AXIAL POSITION

Radius, $r/a_1$	Dimensionless azimuthal field $2\pi H_\theta/Ja_1 \sin \psi$ at axial position $z/L$ of -								
	0	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Ratio of half-length to inside radius of coil, $L/a_1$ , 5; ratio of outside to inside radius, $a_2/a_1$ , 4									
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	- .15674	- .16776	- .19922	- .22345	- .02613	.16932	.13906	.09619	.06598
.50	- .31283	- .33487	- .39831	- .45231	- .05220	.34415	.27814	.19196	.13165
.75	- .46758	- .50066	- .59701	- .69102	- .07816	.52909	.41717	.28689	.19669
1.00	- .62037	- .66449	- .79492	- .94207	- .10396	.72673	.55585	.38051	.26077
1.25	.64319	.58809	.42242	.20851	.57731	.93694	.69364	.47235	.32360
1.50	1.70059	1.63465	1.43281	1.14043	1.15415	1.15696	.82970	.56190	.38485
1.75	2.64221	2.56571	2.32728	1.94800	1.67146	1.38235	.96296	.64862	.44424
2.00	3.51354	3.42680	3.15202	2.68118	2.15173	1.60815	1.09211	.73196	.50146
2.25	4.34009	4.24371	3.93364	3.36980	2.60747	1.82953	1.21573	.81136	.55624
2.50	5.13736	5.03206	4.68686	4.03352	3.04626	2.04194	1.33231	.88628	.60832
2.75	5.91536	5.80203	5.42825	4.68638	3.47283	2.24087	1.44036	.95621	.65748
3.00	6.68074	6.56046	6.16019	5.33951	3.89041	2.42170	1.53850	1.02070	.70350
3.25	7.43862	7.31258	6.89027	6.00231	4.30125	2.57944	1.62549	1.07937	.74623
3.50	8.19202	8.06153	7.62256	6.68307	4.70693	2.70903	1.70035	1.13194	.78552
3.75	8.94361	8.81006	8.36014	7.38863	5.10863	2.80597	1.76249	1.17822	.82130
4.00	9.69523	9.56007	9.10500	8.12348	5.50726	2.86757	1.81166	1.21814	.85351
4.25	8.92359	8.78805	8.33368	7.36402	5.14118	2.89418	1.84804	1.25173	.88214
4.50	8.23643	8.10185	7.65341	6.71442	4.81428	2.88942	1.87225	1.27914	.90723
4.75	7.62145	7.48901	7.05111	6.15667	4.52052	2.85913	1.88518	1.30062	.92884
5.00	7.06872	6.93945	6.51593	5.67474	4.25503	2.80974	1.88800	1.31648	.94712
5.25	6.57009	6.44485	6.03869	5.25487	4.01388	2.74704	1.88199	1.32710	.96215
5.50	6.11890	5.99839	5.61155	4.88602	3.79385	2.67568	1.86847	1.33293	.97411
5.75	5.70939	5.59402	5.22814	4.55936	3.59230	2.59916	1.84870	1.33439	.98318
6.00	5.33678	5.22714	4.88258	4.26793	3.40699	2.51998	1.82385	1.33196	.98955
6.25	4.99697	4.89318	4.57018	4.00623	3.23606	2.43993	1.79496	1.32608	.99341
6.50	4.68639	4.58851	4.28677	3.76981	3.07793	2.36022	1.76295	1.31719	.99497
6.75	4.40197	4.31001	4.02890	3.55517	2.93124	2.28175	1.72859	1.30570	.99442
7.00	4.14101	4.05487	3.79355	3.35940	2.79484	2.20501	1.69252	1.29198	.99197
7.25	3.90112	3.82062	3.57813	3.18011	2.66772	2.13041	1.65529	1.27639	.98781
7.50	3.68031	3.60525	3.38049	3.01533	2.54900	2.05815	1.61734	1.25923	.98212
7.75	3.47664	3.40676	3.19863	2.86340	2.43792	1.98838	1.57902	1.24079	.97507
8.00	3.28852	3.22354	3.03092	2.72291	2.33381	1.92113	1.54065	1.22131	.96683
8.25	3.11447	3.05412	2.87591	2.59264	2.23607	1.85643	1.50241	1.20101	.95754
8.50	2.95321	2.89720	2.73234	2.47159	2.14417	1.79425	1.46454	1.18009	.94734
8.75	2.80359	2.75162	2.59911	2.35883	2.05765	1.73453	1.42716	1.15871	.93636
9.00	2.66456	2.61636	2.47524	2.25361	1.97609	1.67721	1.39038	1.13701	.92473
9.25	2.53519	2.49049	2.35987	2.15523	1.89910	1.62222	1.35431	1.11512	.91253
9.50	2.41465	2.37319	2.25224	2.06309	1.82636	1.56949	1.31900	1.09314	.89987
9.75	2.30219	2.26373	2.15167	1.97666	1.75755	1.51888	1.28449	1.07117	.88682
10.00	2.19714	2.16145	2.05756	1.89547	1.69239	1.47036	1.25083	1.04928	.87351
10.50	2.00685	1.97608	1.88662	1.74716	1.57204	1.37920	1.18612	1.00601	.84623
11.00	1.83958	1.81299	1.73573	1.61525	1.46354	1.29530	1.12494	.96373	.81849
11.50	1.69189	1.66886	1.60190	1.49742	1.36541	1.21803	1.06725	.92271	.79066
12.00	1.56087	1.54085	1.48267	1.39173	1.27640	1.14680	1.01296	.88313	.76302

Ratio of half-length to inside radius of coil,  $L/a_1$ , 5; ratio of outside to inside radius,  $a_2/a_1$ , 5

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	-.21468	-.22485	-.25153	-.26159	-.03950	.18012	.16222	.12116	.08806
.50	-.42874	-.44916	-.50322	-.52895	-.07892	.36615	.32479	.24204	.17583
.75	-.64155	-.67237	-.75511	-.80690	-.11820	.56311	.48795	.36234	.26302
1.00	-.85249	-.89391	-1.00708	-1.09836	-.15726	.77403	.65176	.48172	.34933
1.25	.35281	.30056	.15502	.01016	.51084	.99931	.81599	.59981	.43445
1.50	1.35185	1.28857	1.10868	.89782	1.07457	1.23680	.98017	.71621	.51809
1.75	2.23503	2.16056	1.94459	1.65823	1.57889	1.48279	1.14356	.83044	.59993
2.00	3.04791	2.96217	2.70876	2.34045	2.04630	1.73322	1.30519	.94200	.67966
2.25	3.81607	3.71910	3.42741	2.97326	2.48934	1.98440	1.46393	1.05034	.75697
2.50	4.55514	4.44711	4.11692	3.57488	2.91554	2.23319	1.61856	1.15490	.83154
2.75	5.27525	5.15652	4.78824	4.15769	3.32973	2.47686	1.76774	1.25506	.90308
3.00	5.98337	5.85444	5.44934	4.73068	3.73513	2.71289	1.91010	1.35032	.97130
3.25	6.68449	6.54606	6.10602	5.30091	4.13398	2.93868	2.04427	1.44002	1.03594
3.50	7.38203	7.23515	6.76295	5.87446	4.52791	3.15146	2.16882	1.52367	1.09675
3.75	8.07925	7.92467	7.42386	6.45701	4.91809	3.34787	2.28248	1.60076	1.15350
4.00	8.77787	8.61696	8.09187	7.05436	5.30546	3.52400	2.38398	1.67090	1.20604
4.25	9.47959	9.31369	8.76938	7.67230	5.69068	3.67532	2.47226	1.73374	1.25421
4.50	10.18568	10.01622	9.45834	8.31701	6.07431	3.79691	2.54649	1.78907	1.29791
4.75	10.89707	10.72555	10.16010	8.99369	6.45678	3.88427	2.60617	1.83675	1.33710
5.00	11.61445	11.44236	10.87549	9.70594	6.83843	3.93461	2.65122	1.87678	1.37177
5.25	10.80489	10.63368	10.07129	8.92062	6.45283	3.94815	2.68190	1.90930	1.40195
5.50	10.07008	9.90110	9.34870	8.23606	6.10093	3.92845	2.69894	1.93449	1.42773
5.75	9.40125	9.23573	8.69812	7.63777	5.77846	3.88149	2.70339	1.95271	1.44922
6.00	8.79105	8.63008	8.11120	7.11203	5.48191	3.81385	2.69652	1.96435	1.46659
6.25	8.23312	8.07758	7.58050	6.64694	5.20826	3.73162	2.67977	1.96988	1.48002
6.50	7.72202	7.57262	7.09946	6.23233	4.95499	3.63974	2.65460	1.96982	1.48972
6.75	7.25299	7.11027	6.66235	5.86017	4.71997	3.54196	2.62240	1.96471	1.49593
7.00	6.82189	6.68619	6.26414	5.52404	4.50133	3.44107	2.58454	1.95508	1.49888
7.25	6.42503	6.29656	5.90040	5.21868	4.29747	3.33905	2.54212	1.94147	1.49882
7.50	6.05917	5.93787	5.56731	4.93991	4.10700	3.23731	2.49619	1.92438	1.49601
7.75	5.72144	5.60750	5.26150	4.68430	3.92873	3.13684	2.44764	1.90430	1.49070
8.00	5.40919	5.30234	4.98008	4.44905	3.76153	3.03830	2.39721	1.88167	1.48312
8.25	5.12018	5.02020	4.72046	4.23175	3.60451	2.94217	2.34552	1.85690	1.47352
8.50	4.85231	4.75893	4.48046	4.03048	3.45682	2.84874	2.29307	1.83037	1.46211
8.75	4.60370	4.51662	4.25812	3.84353	3.31770	2.75818	2.24031	1.80239	1.44911
9.00	4.37270	4.29158	4.05175	3.66947	3.18648	2.67060	2.18756	1.77328	1.43471
9.25	4.15774	4.08225	3.85979	3.50705	3.06261	2.58604	2.13510	1.74327	1.41910
9.50	3.95756	3.88734	3.68102	3.35520	2.94550	2.50449	2.08316	1.71259	1.40245
9.75	3.77082	3.70554	3.51418	3.21297	2.83468	2.42592	2.03191	1.68145	1.38491
10.00	3.59645	3.53577	3.35824	3.07952	2.72970	2.35027	1.98149	1.65003	1.36663
10.50	3.28085	3.22841	3.07545	2.83614	2.53571	2.20741	1.88355	1.58690	1.32832
11.00	3.00374	2.95839	2.82634	2.62007	2.36073	2.07524	1.78989	1.52413	1.28842
11.50	2.75935	2.72007	2.60577	2.42731	2.20238	1.95301	1.70081	1.46242	1.24765
12.00	2.54290	2.50879	2.40959	2.25461	2.05868	1.83997	1.61641	1.40226	1.20655
13.00	2.17856	2.15265	2.07723	1.95907	1.80864	1.63855	1.46139	1.28777	1.12511
14.00	1.88611	1.86619	1.80812	1.71681	1.59964	1.46562	1.32379	1.18210	1.04655
15.00	1.64813	1.63263	1.58736	1.51584	1.42344	1.31661	1.20198	1.08558	.97220

TABLE I. - Continued. DIMENSIONLESS AZIMUTHAL MAGNETIC FIELD AT CONSTANT CURRENT DENSITY AS  
FUNCTION OF RADIUS AND AXIAL POSITION

Radius, $r/a_1$	Dimensionless azimuthal field $2\pi H_\theta/J_{a_1} \sin \psi$ at axial position $z/L$ of -								
	0	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Ratio of half-length to inside radius of coil, $L/a_1$ , 10; ratio of outside to inside radius, $a_2/a_1$ , 1.5									
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.25	-0.00479	-0.00572	-0.01000	-0.02859	-0.00061	.02731	.00853	.00385	.00212
0.50	-0.00957	-0.01143	-0.01992	-0.05667	-0.00122	.05412	.01698	.00769	.00424
0.75	-0.01432	-0.01709	-0.02968	-0.08375	-0.00183	.07992	.02528	.01149	.00634
1.00	-0.01903	-0.02268	-0.03921	-0.10931	-0.00244	.10421	.03334	.01523	.00843
1.25	1.39002	1.38552	1.36528	1.28082	0.70382	.12653	.04111	.01890	.01049
1.50	2.58969	2.58438	2.56069	2.46389	1.30535	.14647	.04853	.02249	.01252
1.75	2.21116	2.20509	2.17825	2.07137	1.11775	.16374	.05554	.02597	.01452
2.00	1.92621	1.91943	1.88976	1.77514	.97690	.17821	.06210	.02934	.01647
2.25	1.70369	1.69626	1.66408	1.54406	.86723	.18989	.06819	.03257	.01838
2.50	1.52491	1.51687	1.48255	1.35926	.77937	.19892	.07379	.03568	.02024
2.75	1.37795	1.36938	1.33325	1.20862	.70738	.20553	.07889	.03863	.02205
3.00	1.25493	1.24589	1.20829	1.08393	.64730	.21002	.08348	.04144	.02379
3.25	1.15033	1.14089	1.10214	0.97936	.59638	.21269	.08757	.04408	.02548
3.50	1.06024	1.05045	1.01088	0.89071	.55265	.21384	.09119	.04657	.02711
3.75	0.98179	0.97172	0.93160	0.81481	.51468	.21375	.09434	.04890	.02867
4.00	0.91283	0.90254	0.86214	0.74928	.48140	.21268	.09705	.05106	.03016
4.25	0.85171	0.84125	0.80080	0.69223	.45197	.21082	.09935	.05307	.03159
4.50	0.79714	0.78657	0.74629	0.64223	.42575	.20835	.10127	.05492	.03295
Ratio of half-length to inside radius of coil, $L/a_1$ , 10; ratio of outside to inside radius, $a_2/a_1$ , 2									
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	-.01135	-.01349	-.02301	-.05975	-.00146	.05670	.01950	.00903	.00502
.50	-.02267	-.02693	-.04585	-.11883	-.00292	.11272	.03883	.01802	.01003
.75	-.03393	-.04027	-.06837	-.17649	-.00437	.16734	.05785	.02693	.01501
1.00	-.04511	-.05347	-.09040	-.23196	-.00583	.21976	.07639	.03572	.01995
1.25	1.35755	1.34723	1.30192	1.12934	.69958	.26915	.09431	.04434	.02483
1.50	2.55091	2.53872	2.48555	2.28510	1.30028	.31465	.11150	.05277	.02964
1.75	3.62474	3.61079	3.55037	3.32583	1.84114	.35551	.12783	.06097	.03437
2.00	4.62398	4.60838	4.54138	4.29699	2.34461	.39115	.14321	.06891	.03901
2.25	4.09003	4.07290	4.00002	3.74033	2.08138	.42124	.15758	.07656	.04354
2.50	3.66104	3.64251	3.56449	3.29401	1.87053	.44573	.17087	.08390	.04795
2.75	3.30845	3.28866	3.20626	2.92928	1.69777	.46481	.18306	.09091	.05224
3.00	3.01326	2.99235	2.90631	2.62670	1.55357	.47888	.19413	.09758	.05640
3.25	2.76229	2.74040	2.65144	2.37256	1.43136	.48848	.20408	.10388	.06042
3.50	2.54613	2.52341	2.43224	2.15685	1.32642	.49421	.21293	.10982	.06430
3.75	2.35791	2.33449	2.24177	1.97206	1.23530	.49665	.22072	.11539	.06802
4.00	2.19244	2.16846	2.07480	1.81245	1.15542	.49639	.22749	.12059	.07158
4.25	2.04577	2.02137	1.92732	1.67354	1.08479	.49394	.23329	.12541	.07499
4.50	1.91484	1.89013	1.79621	1.55182	1.02187	.48974	.23818	.12987	.07824
4.75	1.79720	1.77230	1.67897	1.44447	0.96546	.48416	.24222	.13396	.08132
5.00	1.69092	1.66595	1.57358	1.34923	0.91458	.47755	.24547	.13770	.08424
5.25	1.59443	1.56947	1.47842	1.26427	0.86843	.47014	.24801	.14109	.08700
5.50	1.50642	1.48158	1.39214	1.18809	0.82638	.46215	.24988	.14416	.08960
5.75	1.42584	1.40120	1.31360	1.11946	0.78790	.45375	.25116	.14690	.09203
6.00	1.35179	1.32743	1.24187	1.05734	0.75254	.44508	.25190	.14933	.09431

Ratio of half-length to inside radius of coil,  $L/a_1$ , 10; ratio of outside to inside radius,  $a_2/a_1$ , 3

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	- .02921	- .03422	- .05504	- .11815	- .00385	.11009	.04581	.02257	.01288
.50	- .05836	- .06833	- .10979	- .23588	- .00771	.21976	.09132	.04505	.02572
.75	- .08737	- .10223	- .16395	- .35266	- .01155	.32849	.13627	.06735	.03849
1.00	- .11617	- .13581	- .21724	- .46778	- .01539	.43559	.18037	.08938	.05117
1.25	1.26902	1.24474	1.14435	.83340	.68764	.54012	.22336	.11106	.06370
1.50	2.44510	2.41637	2.29790	1.92888	1.28596	.64095	.26498	.13231	.07608
1.75	3.5C190	3.46892	3.33343	2.90971	1.82446	.73678	.30499	.15304	.08826
2.00	4.48436	4.44736	4.29604	3.82214	2.32558	.82624	.34318	.17320	.10021
2.25	5.41744	5.37668	5.21084	4.69242	2.80177	.90803	.37937	.19271	.11192
2.50	6.31621	6.27197	6.09301	5.53667	3.26055	.98102	.41339	.21151	.12335
2.75	7.19019	7.14275	6.95216	6.36523	3.70666	1.04436	.44512	.22957	.13447
3.00	8.04581	7.99549	7.79474	7.18493	4.14328	1.09757	.47446	.24683	.14528
3.25	7.37703	7.32413	7.11484	6.48988	3.81739	1.14058	.50136	.26326	.15575
3.50	6.80106	6.74591	6.52957	5.89684	3.53758	1.17371	.52578	.27882	.16587
3.75	6.29951	6.24242	6.02053	5.38677	3.29463	1.19759	.54775	.29351	.17561
4.00	5.85855	5.79983	5.57385	4.94498	3.08163	1.21311	.56729	.30730	.18497
4.25	5.46770	5.40767	5.17896	4.55994	2.89332	1.22127	.58447	.32020	.19394
4.50	5.11873	5.05767	4.82752	4.22236	2.72557	1.22311	.59938	.33219	.20251
4.75	4.80516	4.74337	4.51297	3.92473	2.57515	1.21967	.61212	.34329	.21068
5.00	4.52182	4.45956	4.22999	3.66094	2.43948	1.21189	.62281	.35352	.21844
5.25	4.26452	4.20205	3.97427	3.42595	2.31645	1.20060	.63158	.36288	.22579
5.50	4.02981	3.96737	3.74224	3.21560	2.20434	1.18654	.63856	.37139	.23273
5.75	3.81486	3.75267	3.53093	3.02642	2.10174	1.17032	.64390	.37909	.23926
6.00	3.61730	3.55556	3.33783	2.85556	2.00747	1.15247	.64772	.38600	.24539
6.25	3.43512	3.37401	3.16084	2.70058	1.92053	1.13340	.65016	.39215	.25112
6.50	3.26664	3.20632	2.99814	2.55947	1.84009	1.11347	.65135	.39757	.25646
6.75	3.11041	3.05102	2.84819	2.43052	1.76543	1.09296	.65141	.40230	.26142
7.00	2.96518	2.90685	2.70963	2.31226	1.69593	1.07209	.65045	.40636	.26600
7.25	2.82988	2.77271	2.58131	2.20346	1.63108	1.05106	.64859	.40981	.27022
7.50	2.70360	2.64766	2.46221	2.10306	1.57040	1.03000	.64592	.41266	.27408
7.75	2.58543	2.53084	2.35145	2.01017	1.51351	1.00903	.64254	.41496	.27760
8.00	2.47474	2.42154	2.24819	1.92393	1.46005	.98824	.63854	.41674	.28078
8.25	2.37086	2.31910	2.15181	1.84373	1.40972	.96770	.63398	.41802	.28364
8.50	2.27322	2.22294	2.06167	1.76895	1.36225	.94746	.62894	.41886	.28620
8.75	2.18133	2.13254	1.97722	1.69907	1.31739	.92756	.62348	.41927	.28846
9.00	2.09473	2.04745	1.89797	1.63363	1.27494	.90806	.61767	.41928	.29043

TABLE I. - Concluded. DIMENSIONLESS AZIMUTHAL MAGNETIC FIELD AT CONSTANT CURRENT DENSITY AS  
FUNCTION OF RADIUS AND AXIAL POSITION

Radius, $r/a_1$	Dimensionless azimuthal field $2\pi H_\theta/Ja_1 \sin \psi$ at axial position $z/L$ of -								
	0	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Ratio of half-length to inside radius of coil, $L/a_1$ , 10; ratio of outside to inside radius, $a_2/a_1$ , 4									
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	- .05226	- .06016	- .09076	- .16572	- .00714	.15081	.07375	.03890	.02290
.50	- .10440	- .12016	- .18117	- .33143	- .01427	.30163	.14718	.07768	.04575
.75	- .15633	- .17985	- .27090	- .49701	- .02139	.45234	.21995	.11619	.06849
1.00	- .20793	- .23907	- .35960	- .66215	- .02849	.60263	.29173	.15431	.09107
1.25	1.15463	1.11606	.96679	.58745	.67127	.75194	.36221	.19192	.11343
1.50	2.30829	2.26251	2.08544	1.62951	1.26635	.89942	.43107	.22889	.13553
1.75	3.34291	3.29020	3.08644	2.55489	1.80161	1.04395	.49798	.26511	.15731
2.00	4.30347	4.24413	4.01499	3.40980	2.29950	1.18422	.56265	.30048	.17873
2.25	5.21495	5.14932	4.89633	4.22064	2.77248	1.31879	.62479	.33487	.19974
2.50	6.09252	6.02098	5.74569	5.00390	3.22808	1.44612	.68414	.36821	.22031
2.75	6.94566	6.86862	6.57284	5.77060	3.67102	1.56472	.74044	.40041	.24038
3.00	7.78081	7.69869	7.38434	6.52852	4.10447	1.67316	.79350	.43138	.25993
3.25	8.60251	8.51575	8.18485	7.28334	4.53068	1.77021	.84314	.46106	.27892
3.50	9.41386	9.32293	8.97754	8.03911	4.95116	1.85489	.88921	.48939	.29732
3.75	10.21727	10.12263	9.76491	8.79886	5.36712	1.92656	.93162	.51632	.31511
4.00	11.01452	10.91665	10.54873	9.56453	5.77940	1.98498	.97031	.54182	.33225
4.25	10.28235	10.18173	9.80572	8.81263	5.42637	2.03032	1.00527	.56585	.34874
4.50	9.62857	9.52565	9.14366	8.15041	5.11191	2.06317	1.03652	.58841	.36455
4.75	9.04104	8.93630	8.55031	7.56478	4.82994	2.08444	1.06414	.60948	.37967
5.00	8.51006	8.40394	8.01585	7.04486	4.57561	2.09528	1.08820	.62907	.39410
5.25	8.02775	7.92068	7.53227	6.58153	4.34498	2.09696	1.10890	.64719	.40782
5.50	7.58771	7.48010	7.09301	6.16703	4.13483	2.09079	1.12633	.66386	.42083
5.75	7.18460	7.07683	6.69257	5.79478	3.94251	2.07804	1.14068	.67910	.43314
6.00	6.81398	6.70643	6.32633	5.45919	3.76580	2.05988	1.15213	.69294	.44474
6.25	6.47212	6.36512	5.99038	5.15550	3.60284	2.03735	1.16090	.70544	.45564
6.50	6.15586	6.04972	5.68136	4.87961	3.45205	2.01135	1.16716	.71662	.46584
6.75	5.86249	5.75749	5.39639	4.62812	3.31209	1.98266	1.17114	.72655	.47537
7.00	5.58968	5.48608	5.13299	4.39806	3.18180	1.95195	1.17301	.73526	.48422
7.25	5.33544	5.23345	4.88897	4.18687	3.06025	1.91972	1.17298	.74281	.49242
7.50	5.09800	4.99782	4.66243	3.99249	2.94652	1.88645	1.17123	.74927	.49997
7.75	4.87584	4.77765	4.45172	3.81296	2.83987	1.85250	1.16793	.75467	.50690
8.00	4.66761	4.57155	4.25534	3.64670	2.73966	1.81816	1.16323	.75909	.51323
8.25	4.47213	4.37832	4.07201	3.49234	2.64531	1.78368	1.15731	.76257	.51896
8.50	4.28834	4.19688	3.90055	3.34865	2.55631	1.74924	1.15029	.76517	.52412
8.75	4.11530	4.02627	3.73995	3.21460	2.47222	1.71499	1.14228	.76695	.52874
9.00	3.95218	3.86562	3.58928	3.08925	2.39263	1.68107	1.13345	.76796	.53283
9.25	3.79821	3.71418	3.44776	2.97180	2.31719	1.64756	1.12391	.76824	.53640
9.50	3.65272	3.57123	3.31452	2.86153	2.24560	1.61455	1.11370	.76786	.53950
9.75	3.51509	3.43616	3.18903	2.75782	2.17751	1.58207	1.10294	.76686	.54212
10.00	3.38477	3.30839	3.07065	2.66011	2.11273	1.55019	1.09172	.76528	.54431
10.50	3.14407	3.07274	2.85311	2.48075	1.99211	1.48830	1.06815	.76058	.54742
11.00	2.92708	2.86067	2.65807	2.32007	1.88210	1.42902	1.04349	.75407	.54900
11.50	2.73083	2.66915	2.48252	2.17535	1.78139	1.37240	1.01814	.74604	.54920
12.00	2.55280	2.49563	2.32388	2.04439	1.68884	1.31841	.99242	.73677	.54818

Ratio of half-length to inside radius of coil, $L/a_1$ , 10; ratio of outside to inside radius, $a_2/a_1$ , 5									
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.25	- .07899	- .08931	- .12662	- .20352	- .01123	.18008	.10003	.05641	.03437
.50	- .15784	- .17843	- .25291	- .40734	- .02246	.36049	.19975	.11266	.06867
.75	- .23639	- .26716	- .37853	- .61165	- .03367	.54142	.29886	.16861	.10283
1.00	- .31451	- .35532	- .50316	- .81647	- .04486	.72290	.39703	.22409	.13677
1.25	1.02167	.97101	.78727	.39219	.65083	.90469	.49395	.27896	.17043
1.50	2.14913	2.08885	1.86994	1.39171	1.24184	1.08626	.58931	.33307	.20373
1.75	3.15777	3.08814	2.83496	2.27263	1.77305	1.26684	.68277	.38627	.23662
2.00	4.09260	4.01394	3.72757	3.08082	2.26691	1.44545	.77400	.43843	.26902
2.25	4.97868	4.89135	4.57304	3.84241	2.73590	1.62094	.86268	.48942	.30088
2.50	5.83109	5.73548	5.38667	4.57362	3.18749	1.79203	.94849	.53911	.33213
2.75	6.65946	6.55601	6.17833	5.28531	3.62645	1.95738	1.03111	.58737	.36272
3.00	7.47025	7.35944	6.95468	5.98534	4.05597	2.11558	1.11023	.63410	.39260
3.25	8.26796	8.15027	7.72043	6.67942	4.47825	2.26524	1.18558	.67919	.42171
3.50	9.05581	8.93178	8.47892	7.37214	4.89486	2.40495	1.25691	.72255	.45002
3.75	9.83617	9.70634	9.23276	8.06715	5.30695	2.53333	1.32398	.76411	.47748
4.00	10.61093	10.47586	9.98392	8.76750	5.71542	2.64917	1.38658	.80379	.50405
4.25	11.38136	11.24164	10.73380	9.47555	6.12090	2.75136	1.44464	.84152	.52970
4.50	12.14863	12.00483	11.48359	10.19319	6.52393	2.83906	1.49797	.87727	.55441
4.75	12.91355	12.76628	12.23417	10.92175	6.92490	2.91176	1.54653	.91100	.57814
5.00	13.67685	13.52669	12.98628	11.66205	7.32416	2.96934	1.59032	.94268	.60088
5.25	12.90567	12.75319	12.20684	10.88086	6.95526	3.01213	1.62936	.97230	.62262
5.50	12.20187	12.04764	11.49780	10.17939	6.61913	3.04076	1.66372	.99987	.64333
5.75	11.55693	11.40151	10.85047	9.54804	6.31152	3.05631	1.69353	1.02540	.66302
6.00	10.96381	10.80773	10.25764	8.97850	6.02887	3.06006	1.71893	1.04890	.68168
6.25	10.41652	10.26027	9.71315	8.46334	5.76822	3.05343	1.74012	1.07041	.69931
6.50	9.90999	9.75406	9.21174	7.99607	5.52704	3.03785	1.75728	1.08997	.71592
6.75	9.43994	9.28477	8.74892	7.57101	5.30320	3.01479	1.77066	1.10762	.73152
7.00	9.00265	8.84867	8.32076	7.18316	5.09484	2.98553	1.78049	1.12343	.74611
7.25	8.59494	8.44252	7.92385	6.82819	4.90039	2.95123	1.78703	1.13745	.75971
7.50	8.21401	8.06350	7.55518	6.50231	4.71847	2.91294	1.79052	1.14975	.77233
7.75	7.85745	7.70916	7.21214	6.20225	4.54789	2.87153	1.79121	1.16040	.78400
8.00	7.52306	7.37727	6.89231	5.92519	4.38760	2.82775	1.78935	1.16946	.79474
8.25	7.20902	7.06597	6.59370	5.66859	4.23669	2.78224	1.78517	1.17703	.80457
8.50	6.91363	6.77353	6.31441	5.43037	4.09433	2.73552	1.77890	1.18316	.81352
8.75	6.63540	6.49843	6.05281	5.20865	3.95978	2.68802	1.77075	1.18794	.82161
9.00	6.37296	6.23926	5.80736	5.00178	3.83250	2.64008	1.76093	1.19144	.82887
9.25	6.12523	5.99492	5.57687	4.80835	3.71181	2.59201	1.74962	1.19374	.83532
9.50	5.89101	5.76419	5.36001	4.62710	3.59725	2.54403	1.73699	1.19492	.84101
9.75	5.66936	5.54609	5.15574	4.45692	3.48836	2.49634	1.72320	1.19504	.84595
10.00	5.45940	5.33973	4.96308	4.29684	3.38471	2.44907	1.70840	1.19418	.85018
10.50	5.07143	4.95900	4.60918	4.00361	3.19172	2.35624	1.67630	1.18977	.85662
11.00	4.72145	4.61623	4.29217	3.74157	3.01571	2.26628	1.64161	1.18221	.86057
11.50	4.40476	4.30659	4.00700	3.50606	2.85453	2.17955	1.60509	1.17197	.86226
12.00	4.11736	4.02600	3.74945	3.29330	2.70644	2.09625	1.56737	1.15947	.86192
13.00	3.61728	3.53862	3.30367	2.92427	2.44359	1.94020	1.49020	1.12916	.85599
14.00	3.19928	3.13191	2.93265	2.61564	2.21771	1.79785	1.41299	1.09379	.84435
15.00	2.84689	2.78934	2.62035	2.35418	2.02177	1.66835	1.33751	1.05528	.82835

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